Dynamic Performance Evaluation of Canadian Fixed-Income Funds using Markov Regime Switching Models

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MSc in Management (Finance)

Submitted in partial fulfillment of the requirements for the degree of
Master of Science in Management (Finance)

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Abstract

This thesis examines the performance of Canadian fixed-income mutual funds in the context of an unobservable market factor that affects mutual fund returns. We use various selection and timing models augmented with univariate and multivariate regime-switching structures. These models assume a joint distribution of an unobservable latent variable and fund returns. The fund sample comprises six Canadian value-weighted portfolios with different investing objectives from 1980 to 2011. These are the Canadian fixed-income funds, the Canadian inflation protected fixed-income funds, the Canadian long-term fixed-income funds, the Canadian money market funds, the Canadian short-term fixed-income funds and the high yield fixed-income funds.

We find strong evidence that more than one state variable is necessary to explain the dynamics of the returns on Canadian fixed-income funds. For instance, Canadian fixed-income funds clearly show that there are two regimes that can be identified with a turning point during the mid-eighties. This structural break corresponds to an increase in the Canadian bond index from its low values in the early 1980s to its current high values. Other fixed-income funds results show latent state variables that mimic the behaviour of the general economic activity.

Generally, we report that Canadian bond fund alphas are negative. In other words, fund managers do not add value through their selection abilities. We find evidence that Canadian fixed-income fund portfolio managers are successful market timers who shift portfolio weights between risky and riskless financial assets according to expected market conditions. Conversely, Canadian inflation protected funds, Canadian long-term fixed-income funds and Canadian money market funds have no market timing ability. We conclude that these managers generally do not have positive performance by actively

managing their portfolios. We also report that the Canadian fixed-income fund portfolios perform asymmetrically under different economic regimes. In particular, these portfolio managers demonstrate poorer selection skills during recessions.

Finally, we demonstrate that the multivariate regime-switching model is superior to univariate models given the dynamic market conditions and the correlation between fund portfolios.

Acknowledgement

I would like to express my sincere gratitude to my supervisor Dr. Skander Lazrak for the continuous support through the learning process of this master thesis. I attribute my level of master degree to his patient guidance. Without his encouragement, motivation, caring and immense knowledge, this thesis would not have been completed.

Besides my supervisor, very special thanks to Dr. Mohamed Ayadi who has been a strong and supportive advisor to me in my thesis research. He always provided me with technical information and insightful comments. Furthermore, the thoughtful and detailed feedback from Professor Robert Welch was invaluable and my thesis would not be so organized without his expertise opinions.

My sincere thanks also goes to my external examiner Dr. Xiaofei Li for for his insightful comments and willingness to read my thesis.

I especially thank my parents Mingda Liao and Biyin Lin, for giving birth to me at the first place and encouraging me with their best wishes. I would also thank my sister Yufen Liao and brother-in-law Xin Zhang for all their advice and support. I know I always have my family to count on when times are rough.

Last but not the least, I would like to thank my fiancée, Danying Gao, for her constant love and care. She was always there cheering me up and stood by me through the good times and bad.

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CHAPTER 1

Introduction

The past fifty years have witnessed an unprecedented development in mutual fund theories and portfolio evaluation which has coincided with more accessible and complete databases. The first revolutionary growth in Canadian mutual funds took place in the 1960s, when the total assets of mutual funds increased from $540 million in 1960 to over $1 billion in only three years. Naturally, new measurement methods of asset pricing theory were developed to meet an explosive demand in mutual fund performance evaluation. By the end of 2007, the total assets of Canadian mutual funds were more than $600 billion (almost twice the figure in 2003). However, it rapidly decreased by 15% after the credit crisis in 2008. This sudden crash in mutual funds challenged ordinary unconditional pricing models, and increased the need for better techniques in estimating the dynamic risks involved in volatile portfolios.

The objective of this thesis is to identify skilled Canadian fixed-income fund managers given the variation of an unobservable market factor that affects mutual fund returns. Since traditional theories generally evaluate performance based on non-dynamic and passive benchmarks, they assume constant portfolio exposures and market conditions. However, bond portfolios have dynamic market exposures in different market conditions due to active management strategies and variation in the underlying assets. Therefore, an evaluation procedure that measures mutual fund performance accounting for time-varying management and market circumstances will yield better results than the traditional approach. We expect performance based on state-dependent investment strategies will be different and goodness of fit will increase in the presence of a dynamic state variable. We also examine various specifications of univariate and multivariate regime-switching models for performance evaluation. We conclude that the multivariate setting is superior given the dynamic market conditions and the correlation between fund portfolios.

Our performance evaluation process is given as follows. First, we assume a basic multifactor asset pricing model, assuming market factors linearly correlate to mutual funds return series. Following early literature on fund management evaluation, the factor coefficients represent the exposure of a portfolio to specific market risks and the intercept measures active fund performance. Second, the abnormal fund return is broken down and categorized according to a fund manager's skills. For instance, non-linearity in market factors is incorporated into the model to account for fund managers who adopt investment strategies to outperform peer funds in bull markets or are relatively risk-neutral in bear markets. Third, the performance evaluation is free to be conditional and dynamic. Exposures of the portfolios to market risks depend on the realization of a state variable and fund performance is then based on the joint distribution of regime and fund returns. Thus fund performance is estimated conditionally on market trends in different episodes. Finally, to have a more precise measure of this dominant factor, we use a multivariate model that incorporates a multi-class series to account for cross-correlation of mutual fund returns.

Based on the performance evaluation process above, we find strong evidence that more than one state variable is necessary to explain the dynamics of the returns on Canadian fixed-income funds. For instance, the Canadian Fixed-income Funds clearly show that there are two regimes that can be identified with a turning point during the mid-eighties. This structural break corresponds to the increase of the Canadian bond index from the low values in the early 1980s to its current high value. Other fixed-income funds results show latent state variables that mimic the behaviour of general economic activity. We demonstrate that the multivariate regime-switching model is superior to univariate models given the dynamic market conditions and the correlation between fund portfolios.

We also find Canadian fixed-income fund managers on average do not add value to their portfolio through their selection skills. However, we find empirical evidence that Canadian fixed-income fund managers are market timers who shift portfolio weights between risky and riskless financial assets according to expected market conditions. Conversely, Canadian inflation protected funds, Canadian Long term fixed-income funds and Canadian Money Market funds did not receive any alpha performance or any market timing ability. We conclude that the managers of these three portfolios generally have negative net performance which means they cannot outperform their benchmark portfolios. We also find that the Canadian fixed-income fund portfolios perform asymmetrically in the sense that it has a worse performance in recessions when returns matter the most

Although academia has shed some light on mutual fund performance evaluation, the depth and breadth of research on fixed-income funds is relatively small compared with equity funds. Specifically, fixed-income funds should receive more attention for several reasons. First, investors' demand for diversified mutual fund investment vehicles in recent years has dramatically increased the number and size of fixed-income funds. Second, although fixed-income funds behave differently from other types of funds, the academic work that exclusively focuses on fixed-income funds is very small. Third, an interesting finding in earlier literature is that fixed-income fund performance is easier to assess and the results may be interpreted more intuitively as there are fewer factors in the fixed-income market (Elton *et al*., 1993; Turtle and Zhang, 2012). Since fixed-income fund managers generally expose their portfolios to fewer market risks, the selection of a performance evaluation method is crucial in capturing the dynamic sensitivity of the market factor. Fourth, the measures of underlying states using fund return series alone may not be accurate because fund returns heavily rely on few factors. However, these prevailing market factors can deviate significantly from true states if the factors are not accurate projections of those states. Therefore, fundamentals of the general economy are included to define the ongoing states. Based on this result, we can easily infer how managers are making their investment decisions and whether they are affected by ongoing economic conditions. Finally, most research on fixed-income fund performance has been conducted on the U.S. while only limited research has been done on the Canadian market. Although the U.S. is geographically close to Canada, the underlying assets between these two countries may deviate substantially due to market liquidity, policies, and investment styles. Since many advanced pricing techniques have not been applied to the Canadian market, some of them may generate different inferences in Canada.

To our knowledge, we are the first to test fixed-income fund performance using a conditional asset pricing model with a Markov regime switching approach. Assuming multiple states in market returns, our model is able to capture dramatic variation in long data series and is especially effective at modeling crash and boom patterns of bond returns. Moreover, we can determine if managers have added value to the portfolio in relation to the underlying regime. Furthermore, we will break down the bond fund performance and determine what abilities the fund managers possess under different states. The results are compared to the performance evaluation process based on the original setting and then we investigate the implications of any differences. This research contributes to the literature on Canadian bond funds, as well as to the study of performance evaluation under the Markov regime switching methods.

The remainder of this thesis is organized as follows. In chapter 2, we discuss the literature of mutual fund performance evaluation and the Markov switching procedure. Chapter 3 introduces a flexible mutual fund evaluation model that includes a regime-switching approach. Chapter 4 provides details of data collection and sample construction. The estimation results and analysis are presented in chapter 5. Chapter 6 concludes this thesis and discusses some potential research avenues.

CHAPTER 2

Literature Review

In this chapter, we discuss three related aspects of the previous literature: general mutual fund performance evaluation, fixed-income fund performance evaluation, and regime-switching.

2.1 Literature Review on Mutual Fund Performance Evaluation

Usually mutual fund performance is evaluated relative to a benchmark portfolio along with Jensen’s alpha. The benchmark portfolio is a mixture of assets that have the same magnitude of pertinent factors as the estimated object. The Jensen’s alpha indicates the abnormal returns of the fund manager obtained by active management and outperformance relative to the benchmark portfolio. The benchmark portfolio is created simply by imposing the same risk exposure as the beta of the estimated fund (Sharpe, 1964; Jensen, 1968). Ross (1976) further extended the one-factor pricing model of Sharpe and proposed the Arbitrage Pricing Model with multiple risk factors.

To obtain inferences on the capability of a fund manager, Treynor and Mazuy (1966) proposed the earliest market timing model which examines whether managers obtain excess returns through accurate market predictions. They believed that if a fund manager has superior management capacity, he will shift the weight of the portfolio towards risky market assets when the predicted market return is higher than the risk-free rate. Otherwise, the manager will hold risk-free assets to avoid losses. Treynor and Mazuy tested the performance of 57 managed funds and reported insignificant market timing ability. Merton and Henriksson (1981) assessed the timing ability based on a low-priced option and used an ordinary benchmark model with option variables to estimate timing ability. On the other hand, Black and Treynor (1973) developed an appraisal ratio as an alternative manager selection skill measure. Based on private information, the manager who possesses this skill can selectively reallocate the risky assets without changing the risk exposure of the portfolio to the chosen assets. Admati *et al.* (1986) examined the market timing model assuming a normal distribution of the portfolio return and a managerial exponential utility function. Their empirical evidence shows that the market timing coefficient was positively related to the manager's risk aversion and to the quality of the superior information. Furthermore, they developed a model to distinguish timing ability from selection ability under the assumption of a multivariate normal distribution.

However, traditional methods have some disadvantages as fund evaluation is restricted by assuming portfolios remain unchanged when subject to a dynamic environment. In other words, the risk exposures are defined as constants throughout the estimation period and the alpha is estimated unconditionally based on the constant betas. This is known as unconditional performance evaluation. Since the risk exposures and expected returns for every fund are stationary in the estimation and do not take into account that portfolio strategies can vary with economic conditions, the unconditional approach fails to capture dynamic states, especially after drastic movements in the economy.

Unlike traditional methods, the conditional performance evaluation eliminates the proportion of abnormal returns generates from replicating strategies and utilizing public information, such as lagged interest rates and market indices. Therefore, a manager that routinely mimics lagged public information will not receive abnormal returns when measured conditionally (Ferson and Warther, 1996). Previous literature on conditional mutual fund performance reports higher alpha relative to the unconditional approach (Ferson and Warther, 1996; Ferson and Schadt, 1996). Becker *et al.* (1999) used the market timing model of Ferson and Schadt (1996) to distinguish market timing from selectivity. They assessed the timing ability of over 400 U.S. mutual funds, assuming the manager's utility function varies with respect to excess returns and assuming an exogenous benchmark. The results indicate that their market timing ability appears to be neutral.

2.2 Literature Review on Fixed-income Fund Performance Evaluation

Due to radical increases in the magnitude and complexity of bond fund markets, more and more literature is concerned specifically with bond fund performance. Bond fund performance evaluation theories have developed since the 1990s, and most of the performance evaluation literature is based on linear unconditional asset pricing models. Similar to the results from general fund performance, most bond fund literature shows that managers rarely outperform corresponding benchmarks, and their portfolio returns are skewed to the left. Cornell and Green (1991) studied low-grade U.S. bond funds, which invest more than 66% percent of their total assets in corporate bonds rated lower than BAA by Moody or BBB class by Standard & Poor's during a given month from the Lipper data set between 1960 and 1989. Using a two-factor model, they found that the interest rate and equity market returns significantly accounted for the movements of low-grade fund returns and the price difference between low-grade and high grade bond is insignificant. Elton *et al.* (1993) employed a traditional multi-factor model to study 46 non-municipal U.S. bond funds. They found that U.S. bond fund managers as a group underperformed benchmarks, with the magnitude of Jensen's alpha approximately equal to the management fees. As estimates of mutual fund performance for unconditional pricing models show significantly negative performance, literature has tried to construct more reasonable equivalent portfolios by adding well-known indicators of economic factors. Elton *et al.* (1995) incorporated market indices as well as fundamental economic variables, such as stock indices, aggregate bond index, and unexpected changes in inflation and economic performance, and mortgage return in a relative APT model. They studied U.S. bond funds, excluding high-yield bond funds from 1986 to 1991, using a style-based benchmark performance model. Although fund performance was negative, the APT model appears to be more robust in creating the benchmark and the information factors enhanced the explanatory power of expected returns. The unanticipated changes in the economic factors accounted for significant movement in the expected returns.

In addition to common market factors such as interest rates and equity indices, bond funds have particular indicators that are different from other categories of fund performance evaluation. For dynamic risks in the benchmark portfolios which are conditional on market factors, the pricing model illustrated robustness in model fitting and had significantly higher abnormal returns compared to its unconditional counterpart.

Chang and Huang (1990) investigated long-term bond portfolios from 1963 to 1984, allowing the expected return and the risk exposure of the fund to vary based on information instruments such as term structure, bond indices, equity indices, and a dummy variable for the January effect. Using the general method of moments, they found the January effect latent variable explained a significant proportion of the bond fund returns and that long-term corporate bond funds are fairly priced. Silva *et al.* (2003) were among the earliest researchers who studied European bond fund performance. They collected 638 sets of bond fund data from the markets of Italy, France, Germany, Spain, U.K., and Portugal between February 1994 and December 2000. Their multi-index model included term spread, real bond yield, inverse relative wealth and a dummy variable for the month of January as unobservable latent variables. They estimated the ability of information variables to predict excess returns in the European market and found these variables to have strong explanatory power for the expected returns. The empirical analysis indicates that the multi-index model was superior in explaining the bond fund returns and that the managers (estimated by the conditional model) had better performance compared to the unconditional model.

Bond fund performance has attracted an insignificant amount of research considering its enormous market size and even fewer researchers have paid attention to Canadian bond funds. Although Canada's bond fund market is closely correlated to the U.S. market, it should be studied separately because of its special characteristics such as different volatility in market returns. Ayadi and Kryzanowski (2011) studied 209 surviving bond funds and 94 non-surviving bond funds from 1984 to 2003. They used a conditional multifactor model with six Scotia Capital Canadian bond indices, the TSX Composite index and five instruments such as lagged values of one month Treasury bill yield and term spread. They found that Canadian fund managers as a group have positive performance which equals the fund expenses. Thus, the alpha is roughly zero after deducting management fees. The authors also tried to distinguish luck from management skill using a cross-section bootstrap. Their results indicated that only the most extreme performance in the sample can be attributed to luck, while bad luck (leading to the worst returns) was more obvious than the effects of good luck.

Basically, bond fund managers who possess market timing ability can predict market movements and shift portfolios between cash and bond investments with different maturities and credit risks. The measures of market timing ability in bond funds are similar to the approaches used in general funds except that risky vehicles in bond fund portfolios are different. In any event, Canadian bond fund managers also had unsatisfactory performance on an after-cost basis. Comer *et al.* (2009) developed a model based on the quadratic programming technique of Sharpe (1992) to test whether U.S. high-quality bond fund managers have market timing ability. First, they tested whether or not bond fund managers have timing ability between cash and bonds. Second, they tested for the timing ability of relocating portfolio weights among different bond investment maturities. They conducted the tests based on 84 high-quality corporate bond funds classified by the Morningstar from January 1995 to December 2003. The empirical results were mixed, but managers generally fail to receive abnormal returns either through timing between cash and bonds or across bond maturities. They demonstrated that after deducting transaction costs, bond fund performance cannot outperform the benchmark. Chen *et al.* (2010) adjusted the classical market timing model of Treynor and Mazuy (1966) for nonlinearity. They argued that ordinary measures of bond fund performance may be biased because they cannot separate timing ability from other unrelated nonlinear factors. Some potential uncorrelated nonlinear factors are interim trading, public information, stale prices and the convexity of the underlying assets. The managers of U.S mutual funds between 1962 and 2007 achieved slightly positive timing performance controlling for these nonlinear factors but it did not offset their management fees.

2.3 Literature Review on Incorporating Regime Switching Models

The Regime switching method was introduced by Hamilton (1989) as an econometric model designed to enhance estimates of time series coefficients, especially when the underlying economy seems to change dramatically. To gauge this particular type of time series, the regime-switching model assumes that the dramatic break points in factor and return data are influenced by a latent variable. This variable is called a state or regime which is generated by a special Markov chain procedure and takes on discrete values of 1 or k. The time series data is then measured under joint distributions of unobservable underlying states and time series data. The regime-switching model was able to capture time series variance in dynamic markets and has been widely used in stock market, interest rate, and portfolio asset allocation.

The Markov switching model is very flexible in the sense that specifications, such as mean, variance and autoregressive terms can be specified as state-dependent, either individually or all together, depending on the purpose of the estimation. For example, Nielsen and Olesen (2000) employed a regime-switching model with a different variance in each state to study stock returns in Denmark from 1922 to 1996. They believed that regime-switching procedures can model heteroskedasticity by allowing regime shifts in volatility. The decision on the number of states is open as well, but researchers always try to utilize a more parsimonious model so that it is easier to measure and interpret. A simple two state model setting appears to be more robust and clearly has more inference on mutual fund performance than a single state model. Therefore, most early literature adopted a two-regime model to avoid a dramatic increase in the number of parameters as the number of states increases. Nielsen and Olesen (2000) tested for mean-reversion focusing on first order correlation, and found that Denmark stock returns switched from a regime characterized by high mean and high volatility to an opposite regime at the beginning of the 1970s. Hardy (2001) developed a regime-switching process based on logarithmic returns (RSLN) and then applied this to characterize the return pattern of S&P 500 index and the TSE 300 index. When compared with other common approaches such as the independent lognormal model or the GARCH (1,1), the RSLN model exhibited significant explanatory power for the TSE across different criteria. They also found that the risk for a European option is underestimated using an ordinary lognormal model.

Some of the previous academic research found that two states are not enough to clearly filter the true states in the data. Therefore, some researchers increased the number of states (up to eight in some cases) in order to capture this variance of fund returns. For instance, Maheu *et al.* (2010) found an unrealistically high frequency of switching in the two-state model, so they proposed four ex ante specified states (bull, bear, bull rally and bear rally) to identify regimes for 125 years of weekly U.S. stock return data. Based on this four-state model, the authors built a predictive cumulative density function (CDF) which exhibited stronger predictability than other common models. Elliott and Timmermann (2005) obtained expected returns in a way that incorporates a predictive indicator in the model. The underlying regime can be refined more precisely by observing the target series and a fundamental indicator which is assumed to be under the same distribution, and is driven by an identical first order Markov chain as the target series.

Even though the regime-switching model has been widely used, a majority of the literature focuses on the estimation of changes in fundamental factors, such as interest rates (Ang and Beaert, 2002; Bansal and Tauchen, 2004).

Many researchers combined the Markov chain procedures with a data generating process and utility function to develop investor asset allocation strategies. In the presence of a regime variable, they found that asset allocation strategies are significantly different and that there is substantial improvement by using a multi-state regime switching models for optimal asset allocation (Tu, 2007; Guidolin and Timmermann, 2008). Separating the stock and bond returns into bull and bear markets, Guidolin and Timmermann (2005) assumed a fundamental indicator is influenced by an identical regime variable so that it can be used as state predictor (the dividend yield) to filter the unobservable variable and the transition probability. Their empirical results demonstrated that the strategy of asset allocation is more reliable when the state variable is determined jointly by returns and the economic indicators. Guidolin and Timmermann (2007) investigated the excess returns from NYSE, AMEX, and NASDAQ markets on one-month Treasury bills between 1954 and 1999. Their empirical results suggest a four-state regime-switching model extended with a predictor. Instead of focusing only on separated distributions of different underlying assets, the regime-switching model estimates take into account the correlation between bond and stock. Their results also indicated that investor expectations of market returns have a significant impact on their investment allocation decisions, especially for long-term stock market investors. It is clear from the above discussion that previous literature has, to some extent, investigated excess returns using the multi-regime asset pricing model. However, the focus was mainly on developing asset allocating strategies rather than examining the performance of an asset or the determination of investing characteristics.

There is very little academic work on mutual fund performance evaluation that incorporates an unobservable regime approach. Ferson and Qian (2005) utilized a multi-factor benchmark model incorporated a discrete state-like dummy variable which represents the unobservable state. The empirical result indicated that interest rate term structure appears to be the most informative among various instruments. The analysis of a large sample size (grouped by style of U.S. mutual funds) using a time-varying model showed a better performance in mutual funds than that measured by classical approaches, even though the return is approximately equal to the cost of mutual fund manager fees. Instead of estimating the state by a regime-switching model, changes of state are measured using a dummy variable defined by the level mean-to-variability ratio of the average of the last 60 months' return. However, this approach may fail to capture the most recent stochastic movement in the underlying states based on the return. Specifically, since the measure of mean-to-variability depends on the mean returns from the past estimation period, their method may be in error due to dilution effects, in the sense that the estimated regime can substantially deviate from the true regime when taking past average information. This misspecification is more obvious when there is a jump or crash in the market. In a recent paper, Kosowski (2011) examined the asymmetric performance of domestic U.S. equity funds using a two-state multivariate regime-switching model. He found evidence that U.S. mutual fund managers generally have inconsistent loadings on market factors in different states which is interpreted as evidence of market timing ability. Moreover, U.S. mutual funds are generally considered to give better performance in a recession. Turtle and Zhang (2012) compared various specifications and suggested a regime switching model with one-factor, or a two-factor model with fixed transition probabilities to be the most parsimonious specification to measure the performance of U.S. domestic and global mutual funds.

CHAPTER 3

Methodology

In this chapter, we present and discuss the various (un)conditional benchmark selection and timing models. These models are further augmented with univariate and multivariate regime switching dynamic structures.

3.1 Unconditional Models of Performance Evaluation

Beginning with linear performance evaluation, we consider the simple case of an unconditional CAPM (Sharpe, 1964).

$$r_{p,t} = \alpha_p + \sum_{i=1}^{I} \beta_i f_{i,t} + \varepsilon_{p,t} \tag{1}$$

where $r_{p,t}$ and $f_{i,t}$ are the excess returns of portfolio p on 1-month treasury bill rates and influence factors at time period t, respectively. The coefficients, β_i , estimates the sensitivity of returns to the market factors and the intercept, α_p, represents unconditional performance of portfolio p.

In the classical pricing model, the coefficients measure fund managers' strategies according to the benchmark factors and the intercept is the abnormal return. However, performance measured by the classical multi-factor model is vague since all management skills are represented in Jensen's alpha. Since the evidence indicates that managers of fixed-income funds are usually market timers, especially for the government bond fund managers (Comer *et al.*, 2009), we incorporate a nonlinear term in the pricing regression as Treynor and Mazuy (1966).

$$r_{p,t} = a_p + \sum_{i=1}^{I} \beta_i f_{i,t} + \sum_{j=1}^{J} \Lambda_j f_{j,t}^2 + \varepsilon_{p,t} \tag{2}$$

Treynor and Mazuy (1966) advocate that the third term accounts for convexity in portfolio returns and a fund manager has market timing ability if $\Lambda_p > 0$. If mangers increase portfolio weight on risky assets when the market rises, the fund returns will outperform the benchmark. If the market falls, the portfolio will decrease less than the benchmark by reallocating fund assets to riskless investments. Portfolio managers are not likely to be a market timer when $\Lambda_p = 0$. Thus, the ability of a fixed-income fund manager is estimated by a_p and $\sum_{m=1}^{M} \Lambda_m$ separately.

3.2 Incorporating the Markov Regime Switching Model

Previous literature has focused on the data generating process (DGP) which estimates mutual fund performance based on unconditional markets factors. In this case, it seems inconsistent that fund performance depends on only stationary market effects since portfolio strategies and market factors are unlikely to be stable overtime. For instance, it is common that a long time series spans several dramatic changes which can result from events such as financial crises, changing policies, production technique innovation, war, depression and so on. To capture variables for time series that change dramatically, we model this time variation with a regime-switching model. This is a process designed to capture unobservable random variables that influence observations. Distribution of return series switches upon a change in the discrete random variable which is called a state or regime. The state variable which is governed by a Markov chain state generating procedure. Including a state-dependent process, the multi-factor asset pricing model then becomes:

$$r_{p,t} = a_{p,s_t} + \sum_{i=1}^{I} \beta_{i,s_t} f_{i,t} + \sum_{j=1}^{J} \Lambda_{j,s_t} f_{j,t}^2 + \varepsilon_{p,t} \tag{3}$$

where a_{p,s_t} estimates fund manager's alpha performance in state s_t, and β_{m,s_t} and Λ_{m,s_t} are the risk exposures to market factor $f_{m,t}$ and its square $f_{j,t}^2$, respectively, in state s_t. Moreover, the variance of residuals in our model $\varepsilon_{p,t} \sim N(0, \sigma_{S_t}^2)$ depends on state s_t. Although the state-dependent beta measures various factor loadings in different states so they can account for market timing, the conditional loading does not necessarily measure timing ability because the betas can change with the variation of the underlying asset betas. Therefore, along with the state dependent beta, we incorporate a square term to measure the timing ability in the sense that the quadratic factors can confirm the market timing of a mutual fund. It can also account for the co-skewness and nonlinearity features in mutual fund returns. Our model simplifies to a classical multi-factor pricing model when $k = 1$. In order to avoid estimation on a large number of parameters when the number of states increase, we consider a parsimonious state-dependent pricing model with $k = 2$. It is also more intuitive to interpret portfolio management in two states because typical fund managers make optimal investment decisions (especially market timing decisions) depending on general trends of the economy (for instance a bear or bull market).

Switches between states, s_t, are governed by a transition probability, $\boldsymbol{P}$**,** with elements

$$\mathbf{P}(s_t) = (s_t = j | s_{t-1} = i,) = p_{ij},\ \ i,j = 1{,}2. \tag{4}$$

Each element is just a realization of a first-order Markov chain on a constant transition probability P. Thus, the probability of state s_t switching to value j or i only depends on the most recent value of state, s_{t-1}. The element of transition probability, p_{ij}, denotes the probability that state i will be followed by state j. Since state variable s_t is unobservable, the Markov chain helps to filter the state based on the observable series r_p.

Equation (3) can be extended to a multivariate model and we can also encompass fundamental indicators to allow a joint distribution with fund returns as in Guidolin and Timmermann (2007). Consider a $(n + m) \times 1$ multivariate asset returns combined by a portfolio return series of $\boldsymbol{r}_t = (r_1, r_2, \cdots, r_n)'$ and economic indicators $\boldsymbol{z}_t = (z_1, z_2, \cdots, z_m)'$:

$$\begin{cases} \boldsymbol{r}_t = \boldsymbol{a}_{s_t} + \sum_{i=1}^{I} \boldsymbol{\beta}_{i,s_t} \boldsymbol{f}_{i,t} + \sum_{j=1}^{J} \boldsymbol{\Lambda}_{j,s_t} \boldsymbol{f}_{j,t}^2 + \boldsymbol{\varepsilon}_t \\ \boldsymbol{z}_t = \boldsymbol{c}_t + \boldsymbol{\varepsilon}_{z_t} \end{cases} \tag{5}$$

with $\left(\boldsymbol{\varepsilon}_t' \boldsymbol{\varepsilon}_{z_t}'\right)' \sim \mathrm{N}(0, \boldsymbol{\Sigma}_{s_t})$ with a $(\mathrm{n} + \mathrm{m}) \times (\mathrm{n} + \mathrm{m})$ state-specific variance covariance matrix, $\boldsymbol{\Sigma}_{s_t}$. We consider an indicator regression with no autocorrelative term and a constant, $\boldsymbol{c}_t$, aligned with the specification of Guidolin and Timmermann (2005). Indicator $\boldsymbol{z}_t$, is a fundamental projection of states so that the joint distribution of $\boldsymbol{z}_t$ and $\boldsymbol{r}_t$ is needed to infer the unobservable regimes. The model is quite flexible since we can specify any or all parameters to depend on states. Also the second indicator equation can be removed so that the states are only observed by multivariate fund returns.

Since the state variable cannot be directly observed from the market, fund managers update their inference of state in each period based on market information $\boldsymbol{r}_t$ and $\boldsymbol{r}_t$. $\boldsymbol{\xi}_{t|t}$ is an estimate for unconditional probability $P(S_t = j|\boldsymbol{y}_t; \boldsymbol{\theta})$ for $j = 1$or 2, given the recognition of population parameters θ and it is measured by an iteration equation:

$$\hat{\boldsymbol{\xi}}_{t|t} = \frac{(\boldsymbol{P} \cdot \hat{\boldsymbol{\xi}}_{t-1|t-1}) \odot \boldsymbol{\eta}_t}{\boldsymbol{1}'[(\boldsymbol{P} \cdot \hat{\boldsymbol{\xi}}_{t-1|t-1}) \odot \boldsymbol{\eta}_t]} \tag{6}$$

where $\boldsymbol{P}$ represents (2×2) transition probability matrix with elements defined in equation (6), $\boldsymbol{1}$ represents a $(n \times 1)$ vector of 1s and $\odot$ denotes element-by-element products. $\boldsymbol{\eta}_t'$ contains two $(n \times 1)$ vectors of density function of return data $\boldsymbol{y}_t$ for state equal to 1 and 2. :

$$\begin{aligned}\boldsymbol{\eta}_t &= \begin{bmatrix} f(\boldsymbol{y}_t | S_t = 1, \boldsymbol{y}_{t-1}; \widehat{\boldsymbol{\theta}}) \\ f(\boldsymbol{y}_t | S_t = 2, \boldsymbol{y}_{t-1}; \widehat{\boldsymbol{\theta}}) \end{bmatrix} \\ &= \begin{bmatrix} (2\pi)^{-1/2} \, |\widehat{\boldsymbol{\Sigma}}_{s_t=1}{}^{-1}|^{1/2} \exp[-\frac{1}{2}(\boldsymbol{y}_t - \widehat{\boldsymbol{\mu}}_{s_t=1}) \widehat{\boldsymbol{\Sigma}}_{s_t=1}{}^{-1} (\boldsymbol{y}_t - \widehat{\boldsymbol{\mu}}_{s_t=1})'] \\ (2\pi)^{-1/2} \, |\widehat{\boldsymbol{\Sigma}}_{s_t=2}{}^{-1}|^{1/2} \exp[-\frac{1}{2}(\boldsymbol{y}_t - \widehat{\boldsymbol{\mu}}_{s_t=2}) \widehat{\boldsymbol{\Sigma}}_{s_t=2}{}^{-1} (\boldsymbol{y}_t - \widehat{\boldsymbol{\mu}}_{s_t=2})'] \end{bmatrix}\end{aligned} \tag{7}$$

where $\boldsymbol{y_t} = (\boldsymbol{r}_t' \, \boldsymbol{z}_t')$ and $\boldsymbol{\mu}_{\boldsymbol{s_t}}$ is the mean of equation (7) in state s_t. A 'hat' in equations (6) and (7) on the top of a parameter means it is an estimate. Parameters, $\boldsymbol{\theta}$, are estimated using a maximum likelihood approach.

CHAPTER 4

Data Collection and Sample Selection

In this chapter, we describe our fixed-income funds data in section 4.1 and then we discuss the market factors and economic variables in section 4.2.

4.1 The Fixed-income Funds Data

The monthly mutual funds raw data is obtained from Fundata Canada Inc. for the period between December 1962 and December 2011. We edit the raw data before constructing the fixed-income fund returns. First, we adjust the net asset value per share (NAVPS) when there is a share split in the fund.[1] Second, we deleted 74 funds with only one observation per month in the data. Thirdly, due to missing data, 23 fixed-income funds are removed since their fund types were never reported and we could not find this data from other databases (all of them are non-surviving funds). Fourth, 32 funds are excluded since we cannot categorize these funds due to switches in their fund types over the trading period. Fifth, some funds that temporarily stopped trading for a period of time would usually have a 'jump' in NAPV when trading resumed. We removed the first observation after the fund resumed trading. Sixth, with respect to stale pricing, we removed observations if NAPV stays unchanged over ten successive months and also removed fund series with 15% or more stale prices in the data series. Seventh, if multiple-class funds are managed by the same managers, performance estimation is overstated. To address this issue, we follow Nanda *et al.* (2009) to select a class A series for our sample.[2] Eighth, international funds which have holdings in foreign securities are removed from the sample since our model does not account for exchange rate effects and

[1] Since some funds report their information repeatedly in a month, the splits of shares are adjusted carefully for each observation. Specifically, we find two types of repeated observations in the data. One is that funds report duplicate observations within a month. In this case, the duplicate observations except for the most recent one are removed from that month. Another problem is that funds frequently update their information since the value of dividends keep changing. Therefore, we accumulate all dividends and add them back to the last observation of that month.

[2] According to Nanda *et al.* (2009), A series fund has the longest history and largest market capitalization. It would be able to present all classes in the fund.

other foreign market conditions. Finally, monthly returns for each fixed-income fund are computed after adjusting for dividends.

We have a sample of 895 funds including 403 Canadian fixed-income funds (CFI), 17 Canadian Inflation Protected fixed-income funds (CIPFI), 11 Canadian long-term fixed-income funds (CLTFI), 270 Canadian money market funds (CMM), 121 Canadian short-term fixed-income funds (CSTFI) and 73 High Yield fixed-income funds (HYFI). Canadian balanced funds and Canadian synthetic money market funds are omitted because of their large holdings in equity securities and their short history, respectively. Finally, sub-samples of equally-weighted and value-weighted funds are formed based on fund investing objectives. For value-weighted portfolios, missing values of market capitalization are copied back from more recent data.

[Please insert Table 1 about here.]

The summary statistics for our fund data sample are given in Table 1 where Panel A reports statistics for the return distribution of the entire sample and every subsector which are categorized according to investing objectives. The average of monthly gross returns range from -1.85% for the PH&N extended duration long bond pension trust to 4.05% for the Manulife long-term bond fund. The cross-sectional mean return and the mean return of the full sample is 0.38%. The average standard deviation of the sample is 0.87% while the most volatile fixed-income fund is the First Trust Advantaged Short Duration High Yield Bond fund with a volatility of 4.79%. The table also reports an average positive cross-sectional skewness. Finally, the Canadian Money Market subsection appears to have more extreme returns throughout the estimation period because it has the highest average kurtosis. Panel B reports statistics that equally divide the full sample into three sub periods.

The statistics for portfolios in Table 1 indicate that Canadian bond fund raw returns are generally normal distributed with slightly positive mean, skewness and kurtosis close to three. The CFI and CSTFI portfolios highly correlate with CLTFI portfolio which has highest raw returns in Canadian bond fund market. For CMM portfolio, the low standard deviation and ‘fat’ tails shows that there are outliers in the return series. Moreover, the volatile returns in CIPFI portfolio can be attributed to the idiosyncratic risk due to insufficient number of fund in the portfolio. Fund returns vary throughout sub periods and most of the fund returns decrease over 0.20% while volatility and kurtosis gradually decrease in the successive periods. Similar statistics are in Panels C and D where funds with less than 12 observations are omitted.

[Please insert Table 2 about here.]

Table 2 presents pair-wise correlation coefficients for six value weighted portfolios with the same horizon length. All portfolios have significantly positive correlation with one another except for CMM, which is commonly found have a different return pattern from other fixed-income funds. Moreover, CMM is highly correlated with CSTFI and CLTFI because it uses similar investment vehicles.

[Please insert Table 3 about here.]

The summary statistics of excess returns of Canadian fixed-income funds on 30-day TB rates are reported in Table 3. Except for CMM portfolio, all Canada portfolios illustrate positive excess returns. The sample is then divided equally into three sub periods. Generally, Canadian bond fund portfolios have increasing excess returns but the excess returns on CMM portfolio remained negative throughout the estimation periods. The volatility of excess returns on CFI and CSTFI decreased from period 1 to period 3 and the volatility of CMM was the lowest in all three periods.

4.2 Market Indices and Economic Variables

Other than classical fixed-income factors (such as term structure and default premiums), many studies found a great improvement in model fit by including fundamental variables (e.g. Elton *et al*., 1995; Ferson and Qian, 2005; Du *et al*., 2009; Chen *et al*., 2010). Following the previous studies, we utilize bond market factors such as default premium, term premium, equity market returns, equity market volatility, and economic fundamentals.[3] We include aggregate bond index and mortgage index returns as Elton *et al.* (1995) to better explain the fixed-income fund returns. They believe that since equity indices serve as a reliable factor for individual equities, an aggregate bond index is also able to capture average bond fund return movements. Therefore, we complement our market factors with the aggregate bond market index. All the market factors are obtained from Datastream. We use a DEX capital overall universe index to represent the aggregate bond market return. The term premium is constructed by taking the difference between yields of a ten year government bond index and a one year government bond index. The default premium is the DEX capital long term triple B corporate bond index changes in yields minus the government index with the same maturity. The mortgage spread is measured by returns on Barclays Government National Mortgage Association above U.S. government bond with the same maturity. For fundamental economic variables, we consider the Canadian inflation rate and industrial production growth.

Return series for S&P/TSX composite index is used to represent the overall stock market performance since it accounts for stock effects in some mutual bond funds (such as high yield bond funds) which have a high correlation with stock movements. Given the short history of the Canadian volatility index, we construct a volatility factor by computing monthly variances of S&P/TSX composite index.

[Please insert Table 4 and Table 5 about here.]

Tables 3 and 4 present summary statistics for bond-related factors. In Panel A of Table 4, the changes in aggregate bond index and the default premium have similar mean volatility to fixed-income funds. The default premium is generally less volatile than the aggregate bond index which have about the same volatility level as our fund sample. The default premium and term premium increases over time and have a significant positive correlation as shown in Panel C of Table 5. With respect to the stock factors, correlations

[3] We have considered the inverse relative of wealth as in Ayadi and Kryzanowski (2011) which is a dynamic risk aversion and is defined as a ratio of past of current real wealth. We also have unexpected industrial production growth and unexpected inflation changes. The results of these factors are not reported as they do not increase goodness of fit.

between liquidity, stock returns and equity volatility are consistent with previous findings where high stock market returns usually accompany low liquidity and high volatility.

CHAPTER 5

Empirical Findings

In this chapter, we run a preliminary estimation using Ordinary Least Square (OLS) model to select factors for RS model in section 5.1. Sections 5.2, 5.3, and 5.4 show the empirical findings of univariate regime switching model with various specifications. We explore multivariate regime switching model using a fundamental indicator and multiple fund return series in sections 5.5 and 5.6, respectively.

5.1 Factor Selection

We use a simple OLS model augmented with heteroskedasticity and autocorrelation consistent covariance matrix as a preliminary step to estimate the regime-switching model and to filter potential factors for each portfolio. Table 6 reports the parameter estimates for the OLS regression. We consider up to four market factors and two quadratic market factors. The same table shows that the aggregate bond index is a statistically significant factor for all the market portfolios except for CMM. Moreover, term premium has strong explanatory power in CFI, CSTFI and CMM portfolios and the stock market index is a common explanatory factor for CFI, CLTFI, CMM, and CSTFI.

[Please insert Table 6 about here.]

5.2 Univariate Regime Switching Models of Fixed-income Funds with Alpha not State-Dependent

We investigate the asymmetric strategies of portfolio managers under different states because the Markov-switching model specifies risk exposures and also portfolio performance to vary depending on the discrete value of the state variable. Allowing market factors to depend on the states can be regarded as a mean of measuring market timing ability, even though inconsistent factor loadings in two state do not necessarily account for timing ability since the change in loadings can be caused by changing betas in the underlying assets. Furthermore, the loadings on market factor squares can be interpreted as further exposure to specific market. A manager has significant market timing coefficients means he take more advantage of market timing strategies in the corresponding state. Therefore, we added a timing factor as Ferson *et al.* (2010) to confirm the significance of timing ability.

We first tested the hypothesis that managers have different market exposures but that the alphas are the same in between two states. In this scenario, we assume that outstanding managers will perform consistently under all market conditions and that poor mangers cannot out-perform the market benchmark in multiple states. To test this hypothesis, we specify that the mutual fund alpha is not state-dependent, while the market risk exposures, timing coefficients, and residual variances can vary across states.

To improve on the efficiency of our regime-switching based estimation, we predetermine the combinations of factors based on the results from the simple OLS regression in section 5.1. However, the benchmark factors for fixed-income fund returns should make sense economically. To this end, instead of using the equity premium which has explanatory power in OLS estimation as the only factor in the first run of the regime-switching model, we select another economically significant factor, the aggregate bond index, to measure the return series Canadian High Yield Fixed-income fund portfolio.

The sample comprises all six value-weighed portfolios of CFI, CIPFI, CLTFI, CMM, CSTFI, and HYFI, and the results from the univariate regime-switching model for each individual portfolio are reported in Table 7. Regime 1 is characterized as being a relatively high-volatility state and Regime 2 as a less volatile state.

[Please insert Figure 1 about here]

We match historical recession periods with the switches of prevailing smoothed probabilities of CFI portfolio raw returns and find that the high-volatility state (state 1) coincides with the historical recessions in Canada since 1980. Therefore, we identify state 1 as a recession state and state 2 as an expansion state. Since estimates of a smoothed probability depend on ex ante information, it can be interpreted as an expectation and an inference on the state variable. Thus, the switches in the prevailing state probability have a substantial impact on portfolios as managers are likely to adapt investment strategies according to the anticipated state realization. On the other hand, the smoothed probabilities of CFI excess returns are persistent where only one switch occurs near the middle of the 1980s. We believe the regime-switching model captures a latent variable, possibly related to law or a regulation revision in the mid-80s in Canadian fixed-income markets. There is a correlation between the excess returns of CFI portfolio and the returns of the aggregate bond index. The net returns of CFI portfolio has low returns and high volatility when the aggregate bond index has the same characteristics. A dramatic change occurred at around 1985 in aggregate bond index which leads to CFI portfolio switched to a distribution of high mean and low volatility. Therefore we believe that this event caused a significant improvement in CFI bond funds and finally led to less volatile net returns. The latent variable confirms the ability of our model to identify the dominant influence in fixed-income mutual funds. Since the smoothed probabilities are measured based on ex ante information, the variation in latent state variables can be interpreted as changes in managers' ability to predict future states. In terms of CMM and CSTFI, the smoothed probabilities of net returns are volatile and capture the state of economy.

[Please insert Table 7 about here.]

Generally speaking, the empirical results of the univariate regime-switching model report negative selection skills of Canadian bond fund manager and only the CFI portfolio shows significant market timing ability with an asymmetric alpha. The estimates of return innovation and smoothed probability provide strong evidence of two regimes in the Canadian bond fund market.

Estimates in Panel A of Table 7 show that the CFI portfolio has a significant negative alpha. The Wald test indicates significant asymmetric loadings throughout 11 runs on the aggregate bond index which implies that CFI fund managers use the aggregate bond index as a timing instrument or option-like security.

CMM fund managers as a whole do not add value to the portfolios. To be specific, the alpha performance for CMM portfolios is skewed to the left which indicates bad investment selection ability. Furthermore, loadings on the quadratic factors are insignificant. Also the comparison test for asymmetric coefficients shows indifferent loadings on benchmark factors between the two states. Thus we can conclude that CMM fund managers rely only on passive strategies, and do not add any value to their investors.

We find that the HYFI fund have insignificant alpha and we do not find any support for superior timing ability of HYFI fund managers.

CSTFI portfolios generally receive significant negative alphas as reported in Panel E of Table 7. We did not find evidence that CSTFI fund managers used market timing strategies according to Wald test.

Using a parametric Wald test, 31 out of 33 pairs of return innovations are significantly different between two states which strongly supports that there are two states in Canadian bond fund market.

Over all, we find that only CFI fund managers have active timing ability and all portfolios in the Canadian bond fund market have negative alpha. It is unclear whether or not the positive timing ability can offset the negative alphas in the CFI portfolio.

5.3 Univariate Regime-Switching Models of Fixed-Income Funds with Market Timing Coefficients not State-Dependent

We examine whether Canadian fixed-income funds have different alphas in different states. Based on the results in the previous section, the timing coefficients are rarely significant in both states. Therefore, we restricted loadings on market factor squares to be not state dependent in order to obtain a more parsimonious model. Table 8 reports the estimated outputs of a univariate Markov switching model, where all coefficients are state-dependent except for market timing coefficients. The estimates of factor loadings are similar to the estimates in section 5.2, which confirm the empirical results on market timing performance.

[Please insert Table 8 about here.]

The Wald test reports 3 out of 4 pairs of significant different alphas at a 10% significant level. This indicates that CFI fund portfolio managers have asymmetries in alpha, while the active performance in state 1 is significantly lower than the active performance in state 2. This result demonstrates that CFI fund managers have inconsistent selection ability between the two states and they exhibit worse investment selection skill in state 1. Thus, CFI managers decrease the value of portfolios during a recession.

Therefore, the results of the robustness test depend on fixed-income fund objectives. We find that only CFI has state-dependent alphas, and that CMM and CSTFI performs consistently in both states.

5.4 Univariate Regime-Switching Models of Fixed-Income Funds with Intercept, Betas and Timing Coefficients Not State-Dependent

Results for the CIPFI and CLTFI fund portfolios are not reliable as the optimization procedure fails to converge to a global maximum. This implies that we are unable to obtain the true estimates of the regime-switching coefficients because the model is misspecified. This will happen if the fund managers strictly stick to their unique investment positions and do not change the exposure to market risks between two states. Therefore, we consider a univariate regime-switching model where all coefficients are not restricted to be state-dependent except for the return innovations.

[Please insert Table 9 about here.]

The Empirical results for CFI, CMM, CSTFI and HYFI are consistent with the results in the previous section. Wald tests on the variance reveal two states in the CLTFI portfolio but a single state in CIPFI. Moreover, the CLTFI managers do not demonstrate any superior ability in the estimation period, for selectivity or timing. Therefore, we can conclude that CLTFI fund managers also mimic the benchmark portfolio similar to CMM and CSTFI. Thus, they do not add value to their investors.

According to the likelihood-ratio (LL) test, the specifications for fund performance depend on the fund investment objectives. To be specific, the regime switching model with alpha and beta state-dependent but gamma not state-dependent is appropriate for estimating the performance of CFI and CSTFI portfolios (14 out of 22 tests are significant). The rest of the Canadian bond funds (CIPFI, CLTFI, CMM and HYFI) do not pass the LL test in both models which means the model with alpha, beta and gamma not state dependent is the more parsimonious specification.

5.5 Multivariate Regime-switching Models of Fixed-Income Funds and Fundamental Indicator

Next, we incorporated industrial production growth as a fundamental indicator in the univariate regime-switching model in order to define the state variable as in Guidolin and Timmermann (2007). The time variation of the state variable is now measured by the joint distribution of portfolio returns and economic indicators. We also consider a diagonal variance-covariance matrix and it is presumed to be contemporaneous.

The empirical results show that after adding the macroeconomic information, the multivariate regime switching model yields results similar to the univariate regime switching model. The estimates of smoothed probabilities are consistent which means the addition of fundamental information does not help to filter the economic state.

5.6 Multivariate Regime-switching Models of Fixed-Income Funds

To obtain estimates of fixed-income fund performance that jointly depend on the same latent state variables, we use an alternative multivariate regime-switching model in which the fund portfolios with different investment objectives are jointly estimated. We form a multivariate sample using the three portfolios with the longest trading history, which are CFI, CMM and CSTFI, and incorporate covariance between series as in the multivariate regime-switching model in section 5.4. In order to achieve a parsimonious model, we specify the alpha to be state-dependent and the timing coefficients to be not state-dependent according the results of univariate regime-switching estimation in section 5.4

[Please insert Table 10 about here.]

Table 10 presents the multivariate two-state regime-switching model estimates with up to three passive benchmark factors and two square factors. The results show that the multivariate model is able to pick up the dynamic variations in the state of the economy. The estimates of alpha performance confirm our findings that the intercepts are negative when adjusted for more benchmark factors.

Furthermore, we find that Canadian bond fund managers apply asymmetric risk exposure strategies based on their expectation of state variables as seen in Tables 7, 8, and 9. The loadings on square market factors confirm that fund managers usually apply timing strategies with only one investment vehicle.

Over all, to our knowledge, this is the first thesis to provide specific analysis on the performance of Canadian fixed-income mutual funds using a multivariate regime-switching model. The empirical results show that under joint estimation of three fund series, all portfolios have a negative alpha and the performance is worse in recession periods for the CFI fund portfolio. When take into account state-dependent beta and timing coefficients, we find that CFI managers as a whole do possess timing ability.

CHAPTER 6

Conclusion

The last thirty years have witnessed a dramatic increase in the depth and breadth of the Canadian fixed-income fund market. The great variation in fund market returns challenges the traditional mutual fund performance evaluation approaches. The fixed-income industry seeks advanced techniques that can measure mutual fund performance in the context of changing market conditions.

The present thesis asks the following research question: What is the performance of Canadian fixed-income mutual funds given dynamic market circumstances?

This thesis makes several contributions to the literature. First, it focuses explicitly on Canadian fixed-income fund performance and market timing ability in the presence of regimes that are jointly distributed with the fund returns. Second, it encompasses a Markov chain procedure in the Treynor-Mazuy timing model in order to obtain more inferences on market timing ability when accounting for mutual fund managers' prediction of the dynamic state variable. Third, it explores various specifications in the regime-switching model to filter an appropriate procedure to identify good managers given different economic circumstances. Fourth, to our knowledge, it is the first thesis to evaluate the performance of fixed-income funds using a multivariate regime-switching model which accounts for the correlation of jointly distributed series.

Aligned with previous literature (Elton *et al*., 1993; Turtle and Zhang, 2012), the empirical results indicate that Canadian bond fund return series can be well explained by one or two factors. Except for CMM portfolios which mainly focus only on term premium instruments, portfolios with different investment objectives rely heavily on aggregate bond index returns.

We infer the performance of the economy from the estimates of smoothed probabilities in the regime-switching model where state 1 projects recession and state 2 projects expansion.

Our results for alpha are consistent with the previous literature as the after cost performance ranges from zero to significantly negative. Although the empirical results indicate that CFI mangers possess market timing ability, it is not clear this positive market timing ability can offset its negative alpha. We also find that the CLTFI, CMM CSTFI funds follow the benchmark factor passively and generally do not add value to the portfolio. The comparative performance of regime 1 and regime 2 shows that the CFI portfolio has a worse performance in recession periods. Besides, we find evidence that bond fund returns are sufficient to measure the state variable alone in the sense that adding fundamental information does not help to filter the state of economy. The empirical findings of the multivariate regime-switching model confirms the results from univariate estimation and give better inference on mutual fund performance by considering the correlations between different fund return series. Since in the reality, funds with different investment objectives are isolated from one another, it is better to take into account the correlation of series when estimating the fund performance. Therefore, we believe the multivariate regime-switching model is preferable.

Our evaluation of fixed-income funds can be extended in several ways. Since we find potentially more than one state variable in the fixed-income fund market, more light could be shed on the fixed-income fund literature by including the ARCH extension in the regime-switching model to account for the dynamics in residual variances. Other interesting extensions to research regarding regime-switching methodologies could include developing the framework of a Markov chain so that it could isolate the confounding effects of multiple latent variables.

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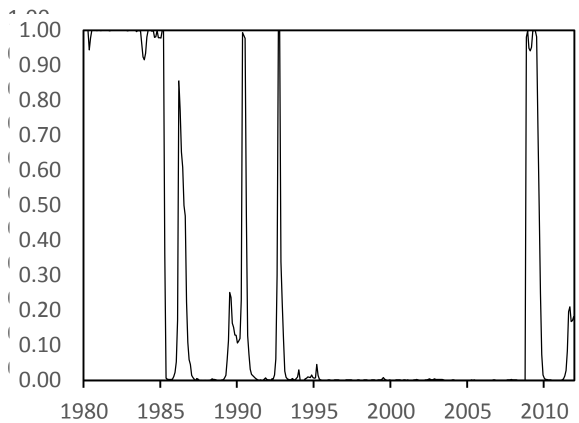
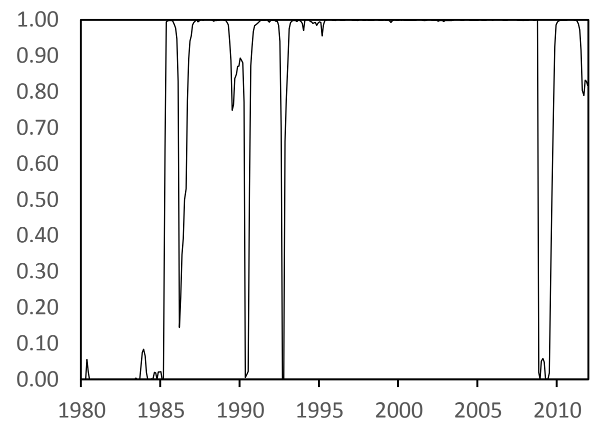
Figure 1: Smoothed Probability of Two States for Fixed-income Mutual Fund Returns

The graphs plot the smoothed probabilities for a two-state regime-switching model comprising returns series during the 1980-2011 period. Panel A and Panel B plot the smoothed probabilities for the Canadian fixed-income fund raw returns.



(a) Panel A: Regime 1 Probability for Two-State Regime Switching Model of CFI



(b) Panel B: Regime 2 Probability for Two-State Regime Switching Model of CFI

Table 1: Summary Statistics for Canadian Fixed-income Fund Monthly Returns

This table presents statistics on distribution of various subsectors of Canadian fixed-income funds (classified based on the objectives of the mutual fund) and the overall sample (demonstrating in the last row of 'All'). Nobs is the number of fund within the estimating group. Panel A reports summary statistics that excluded Canadian Fixed-income Balanced Funds and Canadian Synthetic Money Market Funds. Panel B shows statistics comparisons across different sub periods. Period 1 denotes period from 01/1980 to 08/1990, period 2 is from 09/1990 to 04/2001, and period 3 is from 05/2001 to 12/2011.

Panel A: Summary statistics for mutual funds from 01/1980 to 12/2011

Fund Group	Statistic	Mean	Std.dev.	Minimum	Maximum	Skewness	Kurtosis
Canadian Fixed Income	Mean	0.47%	1.15%	-2.62%	3.47%	-0.0746	0.7486
Nobs=403	Std.dev.	0.25%	0.40%	1.73%	2.03%	0.5063	2.0522
01/1980 – 12/2011	Median	0.45%	1.05%	-2.11%	3.00%	-0.0526	0.2949
	Min	-1.85%	0.32%	-9.36%	-1.85%	-4.8268	-1.1938
	Max	1.65%	3.12%	1.65%	12.42%	1.7217	27.6350
Canadian Inflation Protected Fixed Income	Mean	0.68%	2.16%	-5.83%	6.48%	-0.2511	2.3836
Nobs=17	Std.dev.	0.54%	0.43%	3.05%	2.83%	0.3290	1.7994
12/1994 – 12/2011	Median	0.60%	2.07%	-7.57%	7.51%	-0.2180	3.0402
	Min	-0.40%	1.46%	-9.21%	-0.40%	-0.8784	-0.9457
	Max	1.68%	3.14%	-0.40%	9.34%	0.2397	5.8010
Canadian Long Term Fixed Income	Mean	1.17%	1.89%	-2.62%	4.80%	-0.0475	-0.4308
Nobs=11	Std.dev.	1.01%	0.27%	2.76%	0.98%	0.2209	0.6696
04/1999 – 12/2011	Median	0.82%	1.88%	-2.50%	5.16%	-0.0740	-0.3885
	Min	0.32%	1.48%	-6.68%	3.18%	-0.3476	-1.2788
	Max	4.05%	2.34%	4.05%	6.13%	0.2748	0.8197
Canadian Money Market	Mean	0.24%	0.18%	-0.26%	1.05%	0.6733	6.4894
Nobs=270	Std.dev.	0.20%	0.24%	1.40%	1.93%	1.8129	20.1685
01/1980 – 12/2011	Median	0.23%	0.12%	0.00%	0.49%	0.4366	0.1507
	Min	-1.59%	0.00%	-14.96%	0.00%	-4.7025	-1.7836
	Max	1.52%	2.22%	1.52%	19.28%	9.8096	174.3340
Canadian Short Term Fixed Income	Mean	0.30%	0.59%	-1.51%	2.25%	0.0293	2.9560

Nobs=121	Std.dev.	0.16%	0.35%	1.57%	2.32%	0.9785	5.5707
01/1980 – 12/2011	Median	0.27%	0.55%	-0.98%	1.48%	-0.1143	1.4531
	Min	-0.01%	0.03%	-10.63%	0.10%	-2.0271	-1.4292
	Max	0.75%	1.69%	0.18%	14.12%	5.3416	35.3147
Canadian Synthetic Money Market	Mean	0.34%	1.87%	-5.09%	3.78%	-0.8808	2.9221
Nobs=7	Std.dev.	0.47%	0.92%	4.13%	2.31%	0.8622	4.2391
05/2008 – 12/2011	Median	0.37%	1.53%	-4.06%	3.23%	-0.9841	1.5488
	Min	-1.15%	0.48%	-18.79%	-0.25%	-2.8460	-5.2261
	Max	2.41%	4.79%	2.41%	15.89%	0.8024	15.6305
High Yield Fixed Income	Mean	0.38%	0.87%	-2.02%	2.68%	0.0953	2.9742
Nobs=73	Std.dev.	0.31%	0.70%	2.46%	2.41%	1.2164	0.0031
05/1996 – 12/2011	Median	0.36%	0.89%	-1.43%	2.05%	-0.0122	0.0036
	Min	-1.85%	0.00%	-18.79%	-1.85%	-4.8268	-5.2261
	Max	4.05%	4.79%	4.05%	19.28%	9.8096	174.3340
All	Mean	0.38%	0.87%	-2.02%	2.68%	0.0953	2.9742
Nobs=902	Std.dev.	0.31%	0.70%	2.46%	2.41%	1.2164	0.0031
	Median	0.36%	0.89%	-1.43%	2.05%	-0.0122	0.0036
	Min	-1.85%	0.00%	-18.79%	-1.85%	-4.8268	-5.2261
	Max	4.05%	4.79%	4.05%	19.28%	9.8096	174.3340

Table 1 (continued)

Panel B: Comparison statistics across different sub periods.

Fund Group	Period	Statistic	Mean	Std.dev.	Minimum	Maximum	Skewness	Kurtosis
Canadian Fixed Income	1	Mean	0.71%	1.86%	-3.66%	5.95%	0.2566	0.8244
Nobs=69		Std.dev.	0.22%	0.58%	1.96%	2.58%	0.4288	1.1121
		Median	0.72%	1.91%	-3.37%	4.92%	0.2125	0.9364
		Min	0.11%	0.20%	-9.36%	1.01%	-1.4073	-1.1533
		Max	1.14%	2.98%	0.68%	12.42%	1.2256	4.0351
Canadian Fixed Income	2	Mean	0.48%	1.30%	-2.91%	3.67%	-0.0146	0.8675
Nobs=205		Std.dev.	0.29%	0.39%	1.72%	1.63%	0.562	1.2788
		Median	0.53%	1.26%	-2.25%	3.93%	-0.0824	0.6916
		Min	-0.53%	0.35%	-7.18%	-0.48%	-1.9651	-1.7926
		Max	1.30%	2.48%	0.12%	11.49%	1.7217	11.1549
Canadian Fixed Income	3	Mean	0.44%	1.05%	-1.96%	2.70%	-0.1258	0.2977
Nobs=374		Std.dev.	0.24%	0.40%	1.12%	1.14%	0.4957	1.8994
		Median	0.42%	1.01%	-1.94%	2.80%	-0.1013	-0.0972
		Min	-1.85%	0.32%	-7.90%	-1.85%	-4.8268	-3.2061
		Max	1.65%	4.37%	1.65%	10.59%	1.6847	27.635
Canadian Inflation Protected Fixed Income	2	Mean	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
Nobs=1		Std.dev.						
		Median	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
		Min	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
		Max	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
Canadian Inflation Protected Fixed Income	3	Mean	0.68%	2.16%	-5.83%	6.48%	-0.2573	2.4724
Nobs=17		Std.dev.	0.54%	0.43%	3.05%	2.83%	0.3271	1.8768
		Median	0.60%	2.07%	-7.57%	7.51%	-0.2205	3.0402
		Min	-0.40%	1.46%	-9.21%	-0.40%	-0.8784	-0.9457
		Max	1.68%	3.14%	-0.40%	9.34%	0.2397	5.801
Canadian Long Term Fixed Income	2	Mean	0.10%	1.71%	-2.47%	4.82%	0.906	1.0993
Nobs=1		Std.dev.						
		Median	0.10%	1.71%	-2.47%	4.82%	0.906	1.0993
		Min	0.10%	1.71%	-2.47%	4.82%	0.906	1.0993
		Max	0.10%	1.71%	-2.47%	4.82%	0.906	1.0993
Canadian Long Term Fixed Income	3	Mean	1.18%	1.90%	-2.62%	4.80%	-0.0644	-0.4088
Nobs=11		Std.dev.	1.01%	0.27%	2.76%	0.98%	0.236	0.7171
		Median	0.82%	1.89%	-2.50%	5.16%	-0.074	-0.3885
		Min	0.32%	1.48%	-6.68%	3.18%	-0.3476	-1.2788
		Max	4.05%	2.34%	4.05%	6.13%	0.2748	1.0394
Canadian Money Market	1	Mean	0.86%	0.19%	0.47%	1.27%	0.05	0.7654
Nobs=59		Std.dev.	0.10%	0.09%	0.31%	0.35%	0.9227	3.1651
		Median	0.83%	0.16%	0.57%	1.15%	0.1975	-0.4521
		Min	0.67%	0.02%	-0.21%	1.00%	-3.7116	-1.4033

		Max	1.36%	0.54%	1.36%	2.87%	2.0759	15.3689
Canadian Money Market	2	Mean	0.37%	0.17%	-0.06%	1.08%	0.6449	5.3791
Nobs=168		Std.dev.	0.09%	0.18%	0.94%	1.34%	1.6974	12.9504
		Median	0.38%	0.14%	0.15%	0.70%	0.607	1.6529
		Min	0.00%	0.00%	-7.05%	0.00%	-4.5955	-2.5598
		Max	0.85%	1.15%	0.62%	11.70%	9.3198	90.8313
Canadian Money Market	3	Mean	0.14%	0.13%	-0.13%	0.60%	0.6434	5.0556
Nobs=237		Std.dev.	0.16%	0.32%	0.96%	1.29%	1.9202	17.6287
		Median	0.15%	0.09%	0.00%	0.34%	0.2824	-0.5297
		Min	-1.59%	0.00%	-10.26%	0.00%	-5.5629	-1.8352
		Max	1.52%	3.67%	1.52%	11.92%	10.5029	115.7981
Canadian Short Term Fixed Income	1	Mean	0.85%	1.17%	-2.30%	5.69%	0.691	4.1746
Nobs=13		Std.dev.	0.15%	0.53%	1.65%	3.42%	0.8405	4.5791
		Median	0.92%	1.13%	-2.27%	4.84%	0.552	1.7626
		Min	0.50%	0.07%	-5.96%	1.06%	-0.5354	-0.5117
		Max	0.97%	2.30%	0.79%	13.37%	1.8462	11.3331
Canadian Short Term Fixed Income	2	Mean	0.46%	0.77%	-1.90%	2.51%	-0.0416	2.2893
Nobs=52		Std.dev.	0.12%	0.42%	1.39%	1.11%	0.8675	2.5069
		Median	0.48%	0.75%	-1.74%	2.63%	-0.1034	1.7396
		Min	0.16%	0.10%	-4.34%	0.51%	-1.5717	-0.996
		Max	0.70%	2.34%	0.29%	4.42%	2.4213	9.2798
Canadian Short Term Fixed Income	3	Mean	0.26%	0.53%	-0.99%	1.49%	-0.0592	1.5007
Nobs=116		Std.dev.	0.12%	0.37%	0.88%	1.20%	0.8717	4.2398
		Median	0.25%	0.49%	-0.92%	1.33%	-0.1439	0.2818
		Min	-0.01%	0.03%	-6.06%	0.10%	-2.0271	-1.7597
		Max	0.78%	3.32%	0.18%	8.16%	5.3416	35.3147
High Yield Fixed Income	2	Mean	0.46%	1.27%	-2.54%	3.08%	-0.1942	1.2201
Nobs=9		Std.dev.	0.16%	0.32%	1.38%	1.14%	0.6378	1.9885
		Median	0.45%	1.18%	-1.93%	2.59%	-0.0682	0.1929
		Min	0.24%	0.98%	-5.26%	1.94%	-1.7111	-0.4402
		Max	0.70%	1.93%	-1.23%	5.31%	0.5057	4.7071
High Yield Fixed Income	3	Mean	0.34%	1.91%	-5.18%	3.82%	-0.8962	2.9378
Nobs=69		Std.dev.	0.48%	0.93%	4.21%	2.34%	0.8702	4.2844
		Median	0.37%	1.55%	-4.10%	3.24%	-1.007	1.5462
		Min	-1.15%	0.48%	-18.79%	-0.25%	-2.846	-5.2261
		Max	2.41%	4.79%	2.41%	15.89%	0.8024	15.6305

Table 1 (continued)

Panel C: Summary statistics for mutual funds from 01/1980 to 12/2011 excluding funds with less than 12 months of observations.

Fund Group	Statistic	Mean	Std.dev.	Minimum	Maximum	Skewness	Kurtosis
Canadian Fixed Income	Mean	0.46%	1.16%	-2.82%	3.65%	-0.0770	0.7908
Nobs=365	Std.dev.	0.17%	0.37%	1.64%	2.01%	0.4777	2.0890
01/1980 – 12/2011	Median	0.44%	1.06%	-2.19%	3.10%	-0.0526	0.3035
	Min	-0.71%	0.32%	-9.36%	0.32%	-4.8268	-1.0668
	Max	1.30%	3.10%	-0.58%	12.42%	1.7217	27.6350
Canadian Inflation Protected Fixed Income	Mean	0.62%	2.20%	-6.82%	7.24%	-0.2172	2.6880
Nobs=14	Std.dev.	0.34%	0.45%	2.30%	2.24%	0.3026	1.7112
12/1994 – 12/2011	Median	0.56%	2.12%	-7.81%	8.24%	-0.2180	3.1328
	Min	0.17%	1.46%	-9.21%	2.52%	-0.7294	-0.9457
	Max	1.26%	3.14%	-2.49%	9.34%	0.2397	5.8010
Canadian Long Term Fixed Income	Mean	0.80%	1.92%	-3.53%	5.01%	-0.0208	-0.3365
Nobs=9	Std.dev.	0.25%	0.27%	1.64%	0.95%	0.2165	0.6360
04/1999 – 12/2011	Median	0.80%	1.92%	-3.50%	5.27%	-0.0306	-0.2786
	Min	0.32%	1.48%	-6.68%	3.18%	-0.3476	-1.2241
	Max	1.20%	2.34%	-1.42%	6.13%	0.2748	0.8197
Canadian Money Market	Mean	0.25%	0.19%	-0.28%	1.15%	0.7450	6.8417
Nobs=242	Std.dev.	0.15%	0.21%	1.43%	2.02%	1.8318	20.8110
01/1980 – 12/2011	Median	0.23%	0.13%	0.00%	0.55%	0.4566	0.1432
	Min	0.00%	0.00%	-14.96%	0.00%	-4.7025	-1.7836
	Max	0.83%	2.00%	0.60%	19.28%	9.8096	174.3340
Canadian Short Term Fixed Income	Mean	0.31%	0.61%	-1.65%	2.41%	0.0195	3.1148
Nobs=109	Std.dev.	0.16%	0.34%	1.59%	2.38%	0.9773	5.6633
01/1980 – 12/2011	Median	0.28%	0.57%	-1.05%	1.53%	-0.1460	1.5672
	Min	-0.01%	0.03%	-10.63%	0.10%	-2.0271	-1.1307
	Max	0.75%	1.69%	0.04%	14.12%	5.3416	35.3147
Canadian Synthetic Money Market	Mean	0.43%	1.75%	-5.65%	4.02%	-1.0376	3.6440
Nobs=7	Std.dev.	0.25%	0.80%	4.30%	2.36%	0.8277	4.1916
05/2008 – 12/2011	Median	0.41%	1.49%	-4.55%	3.24%	-1.1987	2.9118
	Min	-0.16%	0.74%	-18.79%	1.68%	-2.8460	-1.6102
	Max	1.09%	4.48%	-0.56%	15.89%	0.6485	15.6305
High Yield Fixed Income	Mean	0.38%	0.86%	-2.17%	2.83%	0.1140	3.1742
Nobs=58	Std.dev.	0.21%	0.66%	2.50%	2.45%	1.2404	0.0021
05/1996 – 12/2011	Median	0.36%	0.91%	-1.63%	2.25%	-0.0037	0.0036
	Min	-0.71%	0.00%	-18.79%	0.00%	-4.8268	-1.7836
	Max	1.30%	4.48%	0.60%	19.28%	9.8096	174.3340
All	Mean	0.46%	1.16%	-2.82%	3.65%	-0.0770	0.7908
Nobs=804	Std.dev.	0.17%	0.37%	1.64%	2.01%	0.4777	2.0890
	Median	0.44%	1.06%	-2.19%	3.10%	-0.0526	0.3035
	Min	-0.71%	0.32%	-9.36%	0.32%	-4.8268	-1.0668
	Max	1.30%	3.10%	-0.58%	12.42%	1.7217	27.6350

Table 1 (continued)

Panel D: Comparison statistics across different sub periods excluding funds with less than 12 months of observations.

Fund Group	Period	Statistic	Mean	Std.dev.	Minimum	Maximum	Skewness	Kurtosis
Canadian Fixed Income	1	Mean	0.71%	1.86%	-3.66%	5.95%	0.2566	0.8244
Nobs=67		Std.dev.	0.22%	0.58%	1.96%	2.58%	0.4288	1.1121
		Median	0.72%	1.91%	-3.37%	4.92%	0.2125	0.9364
		Min	0.11%	0.20%	-9.36%	1.01%	-1.4073	-1.1533
		Max	1.14%	2.98%	0.68%	12.42%	1.2256	4.0351
Canadian Fixed Income	2	Mean	0.49%	1.31%	-2.94%	3.71%	-0.0054	0.8780
Nobs=205		Std.dev.	0.28%	0.39%	1.72%	1.61%	0.5565	1.2785
		Median	0.53%	1.27%	-2.28%	3.99%	-0.0768	0.6927
		Min	-0.53%	0.35%	-7.18%	-0.48%	-1.9651	-1.7926
		Max	1.30%	2.48%	0.12%	11.49%	1.7217	11.1549
Canadian Fixed Income	3	Mean	0.42%	1.05%	-2.09%	2.78%	-0.1375	0.3113
Nobs=338		Std.dev.	0.15%	0.36%	1.01%	1.07%	0.4654	1.9359
		Median	0.42%	1.01%	-1.98%	2.86%	-0.1150	-0.0903
		Min	-0.71%	0.32%	-7.90%	-0.35%	-4.8268	-3.2061
		Max	0.94%	4.37%	0.06%	10.59%	1.6316	27.6350
Canadian Inflation Protected Fixed Income	2	Mean	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
Nobs=1		Std.dev.						
		Median	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
		Min	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
		Max	0.66%	2.10%	-4.78%	6.40%	0.0437	1.1785
Canadian Inflation Protected Fixed Income	3	Mean	0.62%	2.20%	-6.82%	7.24%	-0.2243	2.7895
Nobs=14		Std.dev.	0.34%	0.45%	2.30%	2.24%	0.3012	1.7856
		Median	0.56%	2.11%	-7.81%	8.24%	-0.2205	3.2444
		Min	0.17%	1.46%	-9.21%	2.52%	-0.7294	-0.9457
		Max	1.26%	3.14%	-2.49%	9.34%	0.2397	5.8010
Canadian Long Term Fixed Income	2	Mean	0.10%	1.71%	-2.47%	4.82%	0.9060	1.0993
Nobs=1		Std.dev.						
		Median	0.10%	1.71%	-2.47%	4.82%	0.9060	1.0993
		Min	0.10%	1.71%	-2.47%	4.82%	0.9060	1.0993
		Max	0.10%	1.71%	-2.47%	4.82%	0.9060	1.0993
Canadian Long Term Fixed Income	3	Mean	0.81%	1.92%	-3.53%	5.01%	-0.0395	-0.3121
Nobs=9		Std.dev.	0.25%	0.27%	1.64%	0.95%	0.2360	0.6880
		Median	0.80%	1.93%	-3.50%	5.27%	-0.0306	-0.2786
		Min	0.32%	1.48%	-6.68%	3.18%	-0.3476	-1.2241
		Max	1.20%	2.34%	-1.42%	6.13%	0.2748	1.0394
Canadian Money Market	1	Mean	0.86%	0.19%	0.47%	1.27%	0.0500	0.7654
Nobs=59		Std.dev.	0.10%	0.09%	0.31%	0.35%	0.9227	3.1651
		Median	0.83%	0.16%	0.57%	1.15%	0.1975	-0.4521
		Min	0.67%	0.02%	-0.21%	1.00%	-3.7116	-1.4033

		Max	1.36%	0.54%	1.36%	2.87%	2.0759	15.3689
Canadian Money Market	2	Mean	0.38%	0.18%	-0.07%	1.10%	0.6803	5.4526
Nobs=163		Std.dev.	0.08%	0.18%	0.95%	1.35%	1.6954	13.0521
		Median	0.38%	0.14%	0.15%	0.73%	0.7027	1.6644
		Min	0.02%	0.00%	-7.05%	0.02%	-4.5955	-2.5598
		Max	0.85%	1.15%	0.62%	11.70%	9.3198	90.8313
Canadian Money Market	3	Mean	0.15%	0.13%	-0.14%	0.64%	0.6965	5.2949
Nobs=214		Std.dev.	0.07%	0.30%	0.94%	1.35%	1.9488	18.1752
		Median	0.15%	0.09%	0.00%	0.35%	0.2933	-0.5394
		Min	0.00%	0.00%	-10.26%	0.00%	-5.5629	-1.8352
		Max	0.38%	3.67%	0.38%	11.92%	10.5029	115.7981
Canadian Short Term Fixed Income	1	Mean	0.85%	1.17%	-2.30%	5.69%	0.6910	4.1746
Nobs=13		Std.dev.	0.15%	0.53%	1.65%	3.42%	0.8405	4.5791
		Median	0.92%	1.13%	-2.27%	4.84%	0.5520	1.7626
		Min	0.50%	0.07%	-5.96%	1.06%	-0.5354	-0.5117
		Max	0.97%	2.30%	0.79%	13.37%	1.8462	11.3331
Canadian Short Term Fixed Income	2	Mean	0.46%	0.77%	-1.90%	2.51%	-0.0416	2.2893
Nobs=52		Std.dev.	0.12%	0.42%	1.39%	1.11%	0.8675	2.5069
		Median	0.48%	0.75%	-1.74%	2.63%	-0.1034	1.7396
		Min	0.16%	0.10%	-4.34%	0.51%	-1.5717	-0.9960
		Max	0.70%	2.34%	0.29%	4.42%	2.4213	9.2798
Canadian Short Term Fixed Income	3	Mean	0.26%	0.54%	-1.08%	1.57%	-0.0789	1.5833
Nobs=104		Std.dev.	0.13%	0.37%	0.88%	1.22%	0.8563	4.3234
		Median	0.25%	0.51%	-0.93%	1.40%	-0.1562	0.2935
		Min	-0.01%	0.03%	-6.06%	0.10%	-2.0271	-1.7597
		Max	0.78%	3.32%	0.04%	8.16%	5.3416	35.3147
High Yield Fixed Income	2	Mean	0.46%	1.27%	-2.54%	3.08%	-0.1942	1.2201
Nobs=9		Std.dev.	0.16%	0.32%	1.38%	1.14%	0.6378	1.9885
05/1996 – 12/2011		Median	0.45%	1.18%	-1.93%	2.59%	-0.0682	0.1929
		Min	0.24%	0.98%	-5.26%	1.94%	-1.7111	-0.4402
		Max	0.70%	1.93%	-1.23%	5.31%	0.5057	4.7071
High Yield Fixed Income	3	Mean	0.44%	1.79%	-5.81%	4.09%	-1.0679	3.7165
Nobs=54		Std.dev.	0.26%	0.82%	4.40%	2.40%	0.8302	4.2348
		Median	0.42%	1.51%	-4.73%	3.24%	-1.2351	2.7191
		Min	-0.16%	0.74%	-18.79%	1.68%	-2.8460	-1.6102
		Max	1.09%	4.48%	-0.56%	15.89%	0.6485	15.6305

Table 2: Correlation Matrix for Value-Weighted Fixed-income Fund Portfolio Returns

This table shows correlation matrix for six value-weighted portfolio returns, which are Canadian fixed-income fund portfolio (CFI), Canadian inflation protected fund portfolio (CIPFI), Canadian long term fixed-income funds portfolio (CLTFI), Canadian money market fund portfolio (CMM), Canadian short term fixed-income fund portfolio (CSTFI), and High Yield fixed-income fund Portfolio (HYFI). Canadian synthetic money market fund portfolio is excluded due to short period, other six portfolios are adjusted to have same horizon length. Panel A reports the correlation matrix of fund portfolio returns from 01/1980 to 12/2011, Panel B reports the correlation matrix of fund portfolio returns from 01/1980 to 08/1990, Panel C reports the correlation matrix of fund portfolio returns from 09/1990 to 04/2001, and Panel D reports the correlation matrix of fund portfolio returns from 05/2001 to 12/2011.

Panel A: Correlation matrix of fund portfolio returns from 01/1980 to 12/2011

	CFI	CIPFI	CLTFI	CMM	CSTFI	HYFI
CFI	1					
CIPFI	0.482**	1				
CLTFI	0.921**	0.528**	1			
CMM	-0.059	-0.100	-0.108	1		
CSTFI	0.824**	0.299**	0.639**	0.145	1	
HYFI	0.360**	0.346**	0.274**	-0.137	0.138	1

Panel B: Correlation matrix of fund portfolio returns from 01/1980 to 08/1990

	CFI	CMM	CSTFI
CFI	1		
CMM	0.198*	1	
CSTFI	0.639**	0.201*	1

Panel C: Correlation matrix of fund portfolio returns from 09/1990 to 04/2001

	CFI	CMM	CSTFI
CFI	1		
CMM	0.205*	1	
CSTFI	0.695**	0.352**	1

Panel D: Correlation matrix of fund portfolio returns from 05/2001 to 12/2011

	CFI	CIPFI	CLTFI	CMM	CSTFI	HYFI
CFI	1					
CIPFI	0.556**	1				
CLTFI	0.921**	0.587**	1			
CMM	0.011	-0.053	-0.063	1		
CSTFI	0.841**	0.334**	0.669**	0.154	1	
HYFI	0.334**	0.307**	0.240**	-0.056	0.096	1

Table 3: Summary Statistics for Canadian Fixed-income Fund Portfolio Excess Returns

This table presents statistics on distribution of excess returns of Canadian fixed-income fund portfolios on 30-day TB rates. The sample comprises six value-weighted portfolios, which are Canadian fixed-income fund portfolio (CFI), Canadian inflation protected fund portfolio (CIPFI), Canadian long term fixed-income funds portfolio (CLTFI), Canadian money market fund portfolio (CMM), Canadian short term fixed-income fund portfolio (CSTFI), and High Yield fixed-income fund Portfolio (HYFI). Canadian synthetic money market fund portfolio is excluded due to the short period. The descriptive statistics for the full sample are reported in Panel A and the statistics for three subsamples (separated at September 1990 and May 2001) are shown in Panel B.

Panel A: Summary Statistics for the bond market factors from January 1980 to November 2011

Fund Group	Start	Nobs	Mean	Std. Dev	Minimum	Maximum	Skewness	Kurtosis
CFI	01/08/1980	384	0.16%	1.61%	-5.70%	5.87%	-0.1322	1.2805
CIPFI	01/08/1980	205	0.38%	2.09%	-8.79%	8.80%	-0.1007	3.0621
CLTFI	01/08/1980	153	0.42%	2.02%	-4.70%	5.56%	0.0190	-0.3230
CMM	01/08/1980	384	-0.04%	0.05%	-0.27%	0.22%	-0.3780	4.4974
CSTFI	01/08/1980	384	0.07%	0.85%	-3.60%	6.71%	0.6274	12.8848
HYFI	01/08/1980	188	0.24%	1.57%	-9.84%	4.94%	-1.4995	9.4690

Panel B: Comparison statistics across different sub periods.

Fund Group	Start	Nobs	Mean	Std. Dev	Minimum	Maximum	Skewness	Kurtosis
CFI	01/08/1980	128	-0.02%	2.06%	-5.70%	5.87%	0.0999	0.3689
	01/09/1990	128	0.24%	1.59%	-5.19%	4.50%	-0.2344	0.7516
	01/05/2001	128	0.27%	0.98%	-2.52%	2.82%	-0.1832	-0.1165
CIPFI	01/12/1994	77	0.27%	2.10%	-5.35%	6.11%	0.0497	1.3373
	01/05/2001	128	0.45%	2.09%	-8.79%	8.80%	-0.1919	4.2845
CLTFI	01/04/1999	25	-0.31%	1.70%	-2.84%	4.42%	0.9327	1.1849
	01/05/2001	128	0.57%	2.05%	-4.70%	5.56%	-0.1347	-0.2671
CMM	01/08/1980	128	-0.06%	0.06%	-0.27%	0.22%	0.2957	4.5984
	01/09/1990	128	-0.04%	0.04%	-0.24%	0.07%	-1.5917	5.4193
	01/05/2001	128	-0.02%	0.04%	-0.19%	0.11%	0.5521	3.7634
CSTFI	01/08/1980	128	-0.01%	1.19%	-3.60%	6.71%	1.1262	8.9795
	01/09/1990	128	0.13%	0.73%	-3.29%	1.91%	-1.1516	4.5768
	01/05/2001	128	0.10%	0.46%	-1.21%	1.23%	-0.1446	-0.1383
HYFI	01/05/1996	60	0.17%	1.43%	-4.76%	3.93%	-0.0556	2.0220
	01/05/2001	128	0.27%	1.63%	-9.84%	4.94%	-1.9596	11.6237

Table 4: Summary Statistics for Bond Market Factors

This table reports summary statistics for monthly returns (in %) of eight bond market factors. Nobs is the number of observations in every series. The bond index is the returns on aggregate bond index. The default premium is measured by the difference of DEX capital long term triple B corporate bond index changes in yields and the government index with same maturity. Term premium is measured by the difference between yields of a ten year government bond index and a one year government bond index. Mortgage spread is returns on Barclays Government National Mortgage Association above U.S. government bond with same maturity. The inflation changes are measured by the changes in consumer price index. The production growth is the monthly change industrial production index. Stock returns are measured by the S&P/TSX composite index. The liquidity is the difference between 30-day banker acceptance and 1-month T-bill rates. Equity volatility is the monthly variances of S&P/TSX composite index. All data series begin as presented in Start (in format MM/YYYY), and end up in November 2011. The descriptive statistics for the full sample is reported in Panel A and the statistics for three subsamples (separated at September 1990 and May 2001) is shown in Panel B.

Panel A: Summary Statistics for the bond market factors from January 1980 to November 2011

Factor	Start	Nobs	Mean	Std.dev.	Minimum	Maximum	Skewness	Kurtosis
Bond index	01/1980	384	0.11%	1.89%	-8.16%	7.96%	-0.0095	2.7100
Default premium	01/1980	384	0.12%	0.06%	0.02%	0.33%	1.0598	1.1899
Term premium	01/1980	384	0.09%	0.07%	-0.12%	0.24%	-0.1202	-0.6084
Mortgage spread	01/1980	384	0.06%	0.04%	-0.09%	0.20%	-0.5314	1.3010
Inflation changes	01/1980	384	0.28%	0.40%	-1.04%	2.59%	0.6762	3.5176
Production growth	01/1980	384	0.16%	1.25%	-4.14%	12.31%	2.1247	23.2900
Stock return	01/1980	384	0.06%	0.04%	-0.09%	0.20%	-0.5314	1.3010
Liquidity	01/1980	384	0.49%	4.80%	-25.66%	13.33%	-1.2205	4.6359
Equity volatility	01/1980	384	2.33%	2.07%	-1.83%	19.83%	3.0966	16.1625

Panel B: Comparison statistics across different sub periods.

Factor	Start	Nobs	Mean	Std.dev.	Minimum	Maximum	Skewness	Kurtosis
Bond index	01/01/1980	128	0.04%	2.64%	-8.16%	7.96%	0.1419	0.9239
	01/09/1990	128	0.15%	1.63%	-5.89%	4.00%	-0.4160	1.0002
	01/05/2001	128	0.13%	1.04%	-2.41%	2.87%	-0.0521	-0.1585
Default premium	01/01/1980	128	0.07%	0.02%	0.02%	0.12%	0.5552	0.0882
	01/09/1990	128	0.15%	0.06%	0.06%	0.33%	1.2026	1.6681
	01/05/2001	128	0.14%	0.06%	0.06%	0.31%	0.9092	0.8169
Term premium	01/01/1980	128	0.04%	0.06%	-0.12%	0.21%	0.1194	0.0156
	01/09/1990	128	0.08%	0.05%	-0.01%	0.19%	0.2022	-1.0267
	01/05/2001	128	0.13%	0.06%	0.00%	0.24%	-0.5645	-0.8566
Mortgage spread	01/01/1980	128	0.08%	0.04%	0.00%	0.20%	0.8068	0.9009
	01/09/1990	128	0.07%	0.03%	0.01%	0.15%	0.5876	0.0645
	01/05/2001	128	0.03%	0.05%	-0.09%	0.14%	-0.4963	-0.5881
Inflation changes	01/01/1980	128	0.50%	0.37%	-0.18%	1.63%	0.7186	0.2881
	01/09/1990	128	0.17%	0.34%	-0.82%	2.59%	2.7012	19.6672
	01/05/2001	128	0.16%	0.39%	-1.04%	1.09%	-0.3297	0.4550
Production growth	01/01/1980	128	0.26%	1.67%	-4.12%	12.31%	2.7017	20.4167
	01/09/1990	128	0.27%	0.89%	-2.77%	2.51%	-0.0956	0.6280
	01/05/2001	128	-0.03%	1.02%	-4.14%	3.46%	-0.4295	2.2616
Stock return	01/01/1980	128	0.48%	5.43%	-25.66%	13.33%	-1.2073	4.9177
	01/09/1990	128	0.68%	4.60%	-22.57%	11.19%	-1.2418	4.7618
	01/05/2001	128	0.32%	4.32%	-18.55%	10.62%	-1.2064	3.1444
Liquidity	01/01/1980	128	2.47%	2.08%	-1.83%	10.25%	1.7650	3.5174
	01/09/1990	128	2.27%	1.64%	0.17%	9.92%	1.7057	4.0995
	01/05/2001	128	2.26%	2.43%	0.33%	19.83%	4.2300	23.8678
Equity volatility	01/01/1980	128	0.01%	0.02%	0.00%	0.16%	8.7179	86.7751
	01/09/1990	128	0.01%	0.01%	0.00%	0.07%	3.0517	11.6563
	01/05/2001	128	0.01%	0.03%	0.00%	0.23%	5.8092	40.1545

Table 5: Correlation Matrix for Bond Market Factors

This table presents the pair-wise correlation coefficients for bond market factors. The bond index is the returns on aggregate bond index. The default premium is measured by the difference of DEX capital long term triple B corporate bond index changes in yields and the government index with same maturity. Term premium is measured by the difference between yields of a ten year government bond index and a one year government bond index. Mortgage spread is returns on Barclays Government National Mortgage Association above U.S. government bond with same maturity. The production growth is the monthly change industrial production index. Stock returns are measured by the S&P/TSX composite index. The liquidity is the difference between 30-day banker acceptance and 1-month T-bill rates. Equity volatility is the monthly variances of S&P/TSX composite index. Each pair of series is adjusted to best fit the horizon length. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

	Bond index	Default premium	Term premium	Mortgage spread	Inflation changes	Production growth	Stock return	Liquidity	Equity volatility
Bond index	1								
Default premium	-0.054	1							
Term premium	0.065	0.396**	1						
Mortgage spread	0.033	-0.128*	-0.615**	1					
Inflation changes	-0.001	-0.313**	-0.306**	0.138**	1				
Production growth	-0.145**	-0.099	0.042	-0.063	0.059	1			
Stock return	0.213**	-0.049	0.097	-0.056	0.034	0.006	1		
Liquidity	-0.002	0.020	-0.189**	0.274**	0.010	0.009	-0.165**	1	
Equity volatility	0.019	0.227**	0.095	0.165**	-0.171**	-0.112*	-0.418**	0.463**	1

Table 6: Estimates of OLS Model

This table reports the estimation results for the least square model augmented with heteroskedasticity and autocorrelation consistent covariance matrix:

$$r_{p,t} = a_p + \sum_{i=1}^{I} \beta_i f_{i,t} + \sum_{j=1}^{J} \Lambda_j f_{j,t}^2 + \varepsilon_{p,t}$$

where parameters,β_m, are sensitivity of returns to the market risks, intercept,α_p, is unconditional performance of portfolio p, and$\varepsilon_{p,t} \sim \mathrm{N}(0, \sigma_p^2)$is return innovation. The sample comprises monthly excess returns of six value-weighted portfolios on 30-day TB rates: Canadian Fixed Income Funds (CFI), Canadian Inflation Protected Fixed Income Funds (CIPFI), Canadian Long Term Fixed Income Funds (CLTFI), Canadian Money Market Funds (CMM), Canadian Short Term Fixed Income Funds (CSTFI), and High Yield Fixed Income Funds (HYFI). Market factors are aggregate bond index (f_1), default premium (f_2), term premium (f_3), mortgage spread (f_4), inflation changes (f_5), TSX-300 (f_6), banker acceptance rate (f_7), stock market volatility (f_8). Heteroskedasticity-and-autocorrelation-robust standard errors of coefficients are reported in parenthesis under estimates of coefficients. Estim is the intercepts, Nobs is the number of observations, and $AdjR^2$shows the adjusted R^2. Only the outputs with the highest adjusted R^2 is reported. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

	CFI					CIPFI					CLTFI				
Variable	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Estim	-0.729%***	-0.678%***	-1.068%***	-0.749%***	-1.072%***	-0.099%	0.123%	-0.299%*	0.038%	-0.077%	-0.333%***	-0.334%***	-0.362%***	-0.079%	0.559%
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)
f_1	0.843***	0.842***	0.839***	0.844***	0.836***	0.943***	0.948***	0.975***	0.962***	0.979***	1.782***	1.801***	1.75***	1.809***	1.808***
	(0.034)	(0.034)	(0.034)	(0.034)	(0.029)	(0.124)	(0.124)	(0.124)	(0.122)	(0.123)	(0.089)	(0.06)	(0.083)	(0.062)	(0.06)
f_2			5.133***	0.68	5.219***									-2.308*	-11.408**
			(1.312)	(0.452)	(1.276)									(1.254)	(4.834)
f_3	3.352***	3.143***	3.128***	2.946***	3.073***										
	(0.425)	(0.397)	(0.407)	(0.416)	(0.34)										
f_4							-4.852**		-4.738*	-4.769**	-4.801***	-4.347***	-4.379***	-4.528***	-4.965***
							(2.346)		(2.414)	(1.862)	(1.052)	(1.048)	(1.058)	(1.085)	(1.023)
f_5		-0.126**		-0.104*				0.199	0.433	0.171					
		(0.064)		(0.063)				(0.384)	(0.357)	(0.391)					
f_6					0.007	0.067**	0.066**	0.061**	0.062**	0.061**					
					(0.007)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)					
f_7												0.047	0.045	0.079	0.098*
												(0.054)	(0.053)	(0.056)	(0.057)
f_1^2	-1.333*	-1.265*	-1.101	-1.243*	-1.095						4.074		4.671		
	(0.736)	(0.743)	(0.744)	(0.748)	(0.721)						(4.82)		(4.59)		
f_2^2			-1440.65***		-1453.762***										2760.006*
			(400.265)		(394.48)										(1535.249)
f_5^2								115.611**		116.463**					
								(54.654)		(56.254)					
f_6^2						-0.647**	-0.565**	-0.711**	-0.556**	-0.631**					
						(0.255)	(0.252)	(0.298)	(0.25)	(0.29)					
f_7^2												-0.818***	-0.814***	-0.911***	-0.988***
												(0.258)	(0.254)	(0.262)	(0.265)
Nobs			384					205					154		
$AdjR^2$	0.937	0.938	0.94	0.938	0.94	0.372	0.382	0.382	0.384	0.392	0.873	0.881	0.882	0.884	0.886

Table 6 (continued)

	CMM					CSTFI					HYFI				
Variable	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Estim	-0.084%***	-0.086%***	-0.086%***	-0.083%***	-0.11%***	-0.455%***	-0.643%***	-0.652%***	-0.639%***	-0.464%***	0.312%***	0.107%	0.198%	0.448%*	0.155%
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
f_1						0.271***	0.268***	0.262***	0.261***	0.262***		0.388***		0.371***	0.36***
						(0.024)	(0.024)	(0.033)	(0.022)	(0.022)		(0.068)		(0.06)	(0.06)
f_2					0.396*										
					(0.201)										
f_3	0.284***	0.27***	0.313***	0.248***	0.259***	6.201***	7.003***	7.092***	6.868***	6.094***			-8.241	-14.514**	-10.665*
	(0.039)	(0.037)	(0.083)	(0.035)	(0.038)	(1.707)	(1.631)	(1.817)	(1.582)	(1.624)			(6.721)	(6.088)	(6.2)
f_4							2.061**	2.02**	2.088**						
							(0.998)	(1.011)	(0.999)						
f_6				0.001***					0.013*	0.019**	0.126***	0.116***	0.111***	0.094***	0.101***
				(0.000)					(0.008)	(0.008)	(0.027)	(0.025)	(0.023)	(0.022)	(0.023)
f_7	0.009***	0.009***	0.009***	0.006**	0.009***										
	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)										
f_8		0.426**	0.441**	0.899***	0.453**					5.636***	-2.589	-4.308	-11.41	-31.702***	-14.047
		(0.18)	(0.182)	(0.23)	(0.2)					(1.773)	(9.502)	(9.632)	(8.769)	(4.277)	(9.025)
f_1^2								0.284							
								(0.793)							
f_2^2					-122.128**										
					(61.926)										
f_3^2			-26.88			-1794.659**	-1780.316**	-1808.295**	-1738.93**	-1923.608**			6921.975**	9475.962***	7711.419***
			(44.555)			(850.777)	(850.712)	(916.293)	(823.078)	(824.653)			(3092.149)	(2904.668)	(2902.546)
f_6^2										-0.091					
										(0.088)					
f_7^2	-0.01	-0.031*	-0.031*		-0.03*										
	(0.013)	(0.016)	(0.017)		(0.017)										
f_8^2				-252.07**							-13597.776***	-12720.275***	-11262.904***		-9887.311**
				(118.761)							(3982.419)	(4063.367)	(3892.594)		(3881.419)
Nobs			384					384					188		
$AdjR^2$	0.199	0.215	0.214	0.227	0.228	0.467	0.473	0.472	0.477	0.477	0.435	0.507	0.515	0.566	0.577

Table 7: Estimates of Univariate Regime-Switching Model with Intercept Not State-Dependent

This table reports the estimation output for the regime-switching model: $r_{p,t} = a_p + \sum_{i=1}^{I} \beta_{i,s_t} f_{i,t} + \sum_{j=1}^{J} \Lambda_{j,s_t} f_{j,t}^2 + \varepsilon_{p,t}$ where β_{j,s_t} and $\Lambda_{j,s_t}$are the risk exposure to market factor and its square,$f_{j,t}$ and $f_{j,t}^2$ respectively in state s_t, and $\varepsilon_{p,t} \sim N(0, \sigma_{S_t}^2)$ is the return innovation of portfolio. The intercept, a_p, is the estimate of intercept performance which is not states dependent. Switches of latent variable between two states, s_t , are governed by a transition probability which is a realization of first-order Markov chain on a constant transition probability. We consider a model with k=2,I up to four, and J up to two. The sample comprises monthly excess returns of six value-weighted portfolios on 30-day TB rates: Canadian Fixed Income Funds (CFI), Canadian Inflation Protected Fixed Income Funds (CIPFI), Canadian Long Term Fixed Income Funds (CLTFI), Canadian Money Market Funds (CMM), Canadian Short Term Fixed Income Funds (CSTFI), and High Yield Fixed Income Funds (HYFI).Market factors are aggregate bond index (f_1), default premium (f_2), term premium (f_3), mortgage spread (f_4), inflation changes (f_5), TSX-300 (f_6), banker acceptance rate (f_7), stock market volatility (f_8). Standard errors of coefficients are reported in parenthesis under estimates of coefficients. Estim is the intercepts,σ is the percentage of standard deviation of residues, logli denotes the log-likelihood, and P reports the persistent transition probability p_{11} in state 1 and p_{22}in state 2. N/A indicate we are able to not able to obtain the estimates. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level, respectively.

Panel A: Univariate estimates output of Canadian fixed-income fund portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.452%***		-0.41%***		-0.783%***		-0.76%***		-0.764%***		-0.767%***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
f_1	0.724***	0.986***	0.82***	0.943***	0.675***	0.937***	0.688***	0.952***	0.688***	0.952***	0.68***	0.936***
	(0.022)	(0.011)	(0.02)	(0.017)	(0.021)	(0.009)	(0.025)	(0.011)	(0.027)	(0.011)	(0.02)	(0.009)
f_3					2.426***	3.324***	2.337***	3.258***	2.202	3.46***	2.728***	3.234***
					(0.725)	(0.207)	(0.728)	(0.206)	(2.685)	(0.57)	(0.726)	(0.214)
f_5											-0.185**	-0.018
											(0.091)	(0.04)
f_1^2			-1.959***	1.883***			-0.438	-0.979***	-0.435	-0.98***		
			(0.385)	(0.68)			(0.404)	(0.351)	(0.428)	(0.351)		
f_3^2									115.961	-115.949		
									(1927.634)	(305.124)		
σ	0.593***	0.204***	0.563***	0.145***	0.514***	0.251***	0.515***	0.247***	0.516***	0.247***	0.5***	0.25***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.98***	0.982***	0.985***	0.978***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***
	(0.013)	(0.01)	(0.01)	(0.013)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)
Logli	1645.643		1657.856		1702.705		1707.013		1706.411		1704.744	

Table 7 (Continued)

Variable	(7) S_t=1	(7) S_t=2	(8) S_t=1	(8) S_t=2	(9) S_t=1	(9) S_t=2	(10) S_t=1	(10) S_t=2	(11) S_t=1	(11) S_t=2
Estim	-0.745%***		-1.055%***		-0.764%***		-0.745%***		-1.065%***	
	(0.000)		(0.001)		(0.001)		(0.000)		(0.001)	
f_1	0.684***	0.952***	0.678***	0.946***	0.682***	0.936***	0.683***	0.952***	0.677***	0.939***
	(0.024)	(0.011)	(0.023)	(0.011)	(0.021)	(0.01)	(0.023)	(0.011)	(0.022)	(0.011)
f_2			0.434	4.569***	-0.965	-0.022	-1.021	0.013	0.676	4.657***
			(1.655)	(0.896)	(2.455)	(1.001)	(2.329)	(0.184)	(1.665)	(0.901)
f_3	2.625***	3.179***	3.628***	3.204***	2.949***	3.234***	2.88***	3.167***	3.568***	3.169***
	(0.73)	(0.212)	(0.827)	(0.231)	(1.051)	(0.438)	(0.937)	(0.226)	(0.857)	(0.228)
f_5	-0.193*	-0.02			-0.138	-0.019	-0.146	-0.02		
	(0.099)	(0.04)			(0.224)	(0.041)	(0.151)	(0.04)		
f_6									0.003	0.01***
									(0.011)	(0.003)
f_1^2	-0.137	-1.019***	0.068	-0.695*			-0.064	-1.024***	0.047	-0.532
	(0.431)	(0.351)	(0.402)	(0.357)			(0.385)	(0.351)	(0.364)	(0.357)
f_2^2			1440.656***	-1440.591***					1453.768***	-1453.698***
			(0.908)	(274.345)					(3.593)	(274.978)
σ	0.502***	0.247***	0.48***	0.248***	0.5***	0.25***	0.501***	0.247***	0.479***	0.245***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***
	(0.000)	(0.003)	(0.002)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)	(0.001)	(0.003)
Logli	1708.941		1709.972		1704.836		1709.033		1714.78	

Table 7 (Continued)

Panel B: Univariate estimates output of Canadian Inflation Protected Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.141%		-0.163%		-0.199%		-0.093%		0.049%		0.075%	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.002)	
f_1	1.048***	1.931***	2.785***	0.819***	1.794***	0.859***	1.751***	0.85***	1.416***	0.573***	1.773***	0.865***
	(0.105)	(0.085)	(0.838)	(0.139)	(0.423)	(0.096)	(0.446)	(0.097)	(0.311)	(0.147)	(0.515)	(0.094)
f_4											-3.286	-5.411**
											(10.532)	(2.126)
f_6					0.262***	0.049*	0.272**	0.032	0.129**	0.014	0.261**	0.048*
					(0.077)	(0.025)	(0.119)	(0.027)	(0.061)	(0.027)	(0.108)	(0.024)
f_1^2			-53.149*	3.219					-8.103	2.433		
			(32.043)	(5.533)					(12.709)	(6.065)		
f_6^2							0.045	-0.472*	-0.829	-0.646***		
							(0.762)	(0.261)	(0.542)	(0.244)		
σ	1.703***	0.000	3.006**	1.469***	2.303**	1.452***	2.298**	1.437***	2.03***	1.262***	2.453**	1.431***
	(0.000)	N/A	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.999***	0.000	0.88***	0.991***	0.902***	0.992***	0.898***	0.992***	0.944***	0.978***	0.896***	0.992***
	(0.000)	(0.000)	(0.11)	(0.01)	(0.084)	(0.008)	(0.086)	(0.009)	(0.048)	(0.018)	(0.093)	(0.008)
Logli	549.274		557.151		561.829		563.465		564.574		564.93	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	0.137%		-0.269%*		0.183%		0.054%		-0.009%	
	(0.002)		(0.002)		(0.002)		(0.002)		N/A	
f_1	1.777***	0.856***	2.004***	0.889***	0.95***	14.047	1.834***	0.873***	0.967***	0.347
	(0.557)	(0.097)	(0.657)	(0.094)	(0.099)	N/A	(0.541)	(0.093)	(0.087)	N/A
f_4	-4.493	-4.879**			-5.23**	4.568	-2.16	-4.917**	-4.583**	4.971
	(11.543)	(2.162)			(2.404)	N/A	(10.892)	(2.148)	(1.775)	N/A
f_5			-0.955	0.234			-0.749	0.57*	-0.182	-0.016
			(3.241)	(0.385)			(1.57)	(0.334)	(0.295)	N/A
f_6	0.273	0.034	0.552***	0.024	0.087***	9.092	0.55***	0.03	0.03	0.936
	(0.174)	(0.026)	(0.191)	(0.026)	(0.025)	N/A	(0.198)	(0.025)	(0.025)	N/A
f_7					-0.084	-0.706				
					(0.055)	N/A				
f_5^2			-115.567	115.637*					116.619***	-116.458***
			(825.705)	(63.255)					(0.012)	(0.021)
f_6^2	0.128	-0.375	2.003	-0.504**			1.671	-0.408	-0.743***	2.503
	(1.133)	(0.262)	(1.689)	(0.254)			(1.196)	(0.257)	(0.234)	N/A
σ	2.443**	1.423***	2.203	1.436***	1.623***	0.001	2.133**	1.431***	1.497***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	N/A	(0.000)	(0.000)	(0.000)	N/A
P	0.89***	0.992***	0.826***	0.993***	0.999***	0.000	0.837***	0.993***	0.971***	0.000
	(0.097)	(0.009)	(0.158)	(0.008)	(0.000)	(0.000)	(0.136)	(0.007)	(0.012)	(0.000)
Logli	565.967		566.207		559.941		567.413		593.601	

Table 7 (Continued)

Panel C: Univariate estimates output of Canadian Long Term Fixed-income Fund Portfolio

Variable	(1) S_t=1	(1) S_t=2	(2) S_t=1	(2) S_t=2	(3) S_t=1	(3) S_t=2	(4) S_t=1	(4) S_t=2	(5) S_t=1	(5) S_t=2	(6) S_t=1	(6) S_t=2
Estim	-0.554%		-0.49%***		-0.3%***		-0.292%***		-0.242%***		-0.117%	
	N/A		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
f_1	1.828***	1.316	1.807***	1.33	1.797***	1.198	1.763***	1.261	1.777***	1.226***	1.819***	-1.121***
	(0.058)	N/A	(0.075)	N/A	(0.062)	N/A	(0.072)	N/A	(0.073)	(0.051)	(0.057)	(0.01)
f_4					-5.603***	4.727	-5.11***	4.779	-4.491***	3.697***	-3.905***	3.805***
					(1.114)	(6.641)	(1.032)	N/A	(1.048)	(0.000)	(1.095)	(0.003)
f_7											-0.083***	1.472***
											(0.028)	(0.048)
f_1^2			3.294	-3.165			4.576	-4.024	4.82	-4.263***		
			(4.378)	N/A			(4.193)	N/A	(4.249)	(0.002)		
f_4^2									-1659.208***	1659.206***		
									(0.001)	(0.000)		
σ	0.813***	0.000	0.739***	0.000	0.768***	0.000	0.707***	0.000	0.716***	0.000	0.699***	0.000
	(0.000)	N/A	(0.000)	N/A	(0.000)	N/A	(0.000)	N/A	(0.000)	N/A	(0.000)	N/A
P	0.999***	0.000	0.999***	0.000	0.999***	0***	0.999	0.706*	0.999***	0.442	0.998***	0.714**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	N/A	(0.401)	(0.000)	(0.505)	(0.004)	(0.306)
Logli	538.133		538.512		547.993		547.753		548.628		559.244	

Variable	(7) S_t=1	(7) S_t=2	(8) S_t=1	(8) S_t=2	(9) S_t=1	(9) S_t=2	(10) S_t=1	(10) S_t=2	(11) S_t=1	(11) S_t=2
Estim	-0.3%**		-0.31%***		0.083%		-0.007%		0.495%***	
	(0.001)		(0.001)		(0.002)		(0.001)		(0.002)	
f_1	1.793***	-0.321***	1.749***	-0.479	1.844***	-1.064	1.806***	-1.067	1.822***	-0.952
	(0.055)	(0.069)	(0.066)	N/A	(0.058)	N/A	(0.055)	N/A	(0.052)	N/A
f_2					-2.241*	2.051	-2.345**	2.393	-11.652***	11.453
					(1.18)	N/A	(1.011)	N/A	(1.062)	N/A
f_4	-5.621***	4.333***	-5.089***	4.37	-4.03***	3.906	-7.206***	4.523	-5.832***	4.958
	(1.088)	(0.001)	(1.016)	N/A	(1.12)	N/A	(1.124)	N/A	(1.028)	N/A
f_7	0.068	0.992	0.05	1.154	-0.062**	1.218	0.106*	1.213	0.154**	0.638
	(0.06)	N/A	(0.057)	N/A	(0.029)	N/A	(0.061)	N/A	(0.059)	(0.562)
f_1^2			5.074	-4.657						
			(3.809)	N/A						
f_2^2									2760.004	-2760.006
									N/A	N/A
f_7^2	-0.911**	0.859***	-0.833**	0.852			-0.96***	0.942	-1.265***	1.006
	(0.372)	(0.003)	(0.349)	N/A			(0.367)	N/A	(0.354)	(16.24)
σ	0.683***	0.000	0.641***	0.000	0.724***	0.000	0.679***	0.000	0.642***	0.000
	(0.000)	N/A	(0.000)	N/A	(0.000)	N/A	(0.000)	N/A	(0.000)	N/A
P	0.999***	0***	0.999***	0.017	0.999***	0.038	0.999***	0.117	0.999***	0.058
	(0.000)	(0.000)	(0.000)	(0.139)	(0.000)	(0.082)	(0.000)	(0.184)	(0.001)	(0.113)
Logli	555.089		553.801		558.939		560.8		564.959	

Table 7 (Continued)

Panel D: Univariate estimates output of Canadian Money Market Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.05%***		-0.05%***		-0.079%***		-0.084%***		-0.08%***		-0.071%***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
f_3	-0.235	0.235***	-0.26	0.26**	0.308***	0.187***	0.314***	0.182***	-0.108	0.01	-0.261***	0.261***
	N/A	(0.035)	(0.457)	(0.105)	(0.053)	(0.031)	(0.051)	(0.029)	(0.143)	(0.068)	(0.03)	(0.039)
f_7					0.004***	0.013***	0.007*	0.018***	0.005	0.017***	-0.006	0.006***
					(0.002)	(0.001)	(0.004)	(0.001)	(0.004)	(0.002)	(0.004)	(0.002)
f_8											-0.346	0.346**
											(1.126)	(0.145)
f_3^2			15.434	-15.434					289.01**	114.742***		
			(380.64)	(58.716)					(112.727)	(33.527)		
f_7^2							-0.039	-0.046***	-0.019	-0.044***		
							(0.053)	(0.008)	(0.059)	(0.01)		
σ	0.053***	0.043***	0.053***	0.043***	0.06***	0.015***	0.057***	0.014***	0.063***	0.016***	0.053***	0.043***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.841***	0.841***	0.841***	0.841***	0.944***	0.944***	0.957***	0.948***	0.958***	0.959***	0.841***	0.841***
	(0.1)	(0.041)	(0.116)	(0.044)	(0.026)	(0.02)	(0.02)	(0.019)	(0.021)	(0.017)	(0.096)	(0.023)
Logli	2394.314		2394.139		2530.068		2535.785		2531.066		2422.653	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.075%		-0.09%***		-0.086%***		-0.076%***		-0.108%***	
	N/A		(0.000)		(0.000)		(0.000)		(0.000)	
f_2									-0.142	0.437***
									(0.248)	(0.1)
f_3	0.257***	0.126	0.13	0.066	0.246***	0.235***	-0.248**	0.248***	0.362***	0.191***
	(0.065)	N/A	(0.105)	(0.193)	(0.065)	(0.018)	(0.108)	(0.039)	(0.132)	(0.067)
f_6					0.001	0.001***	-0.001	0.001**		
					(0.001)	(0.000)	(0.002)	(0.001)		
f_7	0.001	0.013***	0.01***	0.033***	0.003*	0.012***	-0.006	0.006***	0.008**	0.01***
	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.001)	(0.004)	(0.002)	(0.003)	(0.001)
f_8	0.725***	-0.083	0.253	-0.084	0.519*	0.612***	-0.899	0.899***	-0.183	0.404***
	(0.189)	(0.121)	(0.21)	(0.156)	(0.273)	(0.099)	(1.34)	(0.297)	(0.421)	(0.107)
f_2^2									119.561	-119.557***
									(101.072)	(28.798)
f_3^2	-6.415	28.326	116.428*	50.362					8.612	-8.61
	(33.215)	N/A	(62.112)	(114.327)					(42.495)	(39.555)
f_7^2			-0.018	-0.482***						
			(0.025)	(0.03)						
f_8^2							252.07***	-252.07		
							(0.147)	(158.807)		
σ	0.058***	0.015***	0.056***	0.014***	0.061***	0.016***	0.053***	0.043***	0.07***	0.017***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.949***	0.945***	0.95***	0.938***	0.937***	0.948***	0.841***	0.841***	0.873***	0.927***
	(0.019)	(0.017)	(0.021)	(0.023)	(0.026)	(0.019)	(0.094)	(0.022)	(0.055)	(0.021)
Logli	2534.338		2530.115		2540.033		2425.138		2533.622	

Table 7 (Continued)

Panel E: Univariate estimates output of Canadian Short Term Fixed-income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.086%***		-0.062%**		-0.307%***		-0.357%***		-0.328%***		-0.479%***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.001)	
f_1	0.287***	0.26***	0.299***	0.3***	0.272***	0.258***	0.287***	0.249***	0.278***	0.282***	0.274***	0.265***
	(0.055)	(0.017)	(0.063)	(0.02)	(0.05)	(0.016)	(0.06)	(0.016)	(0.066)	(0.019)	(0.037)	(0.019)
f_2												
f_3					4.134**	2.296***	2.093	5.517***	1.891	5.446***	5.743***	2.899***
					(1.74)	(0.308)	(4.671)	(0.908)	(4.551)	(0.862)	(1.344)	(0.353)
f_4											-1.377	2.038***
											(1.524)	(0.501)
f_1^2			-0.244	-2.437***					0.084	-1.766***		
			(1.106)	(0.704)					(1.301)	(0.66)		
f_3^2							1794.663	-1794.586***	1828.768	-1828.696***		
							(3605.344)	(470.29)	(3472.619)	(453.649)		
σ	1.373***	0.377***	1.376***	0.389***	1.235***	0.348***	1.379***	0.373***	1.324***	0.369***	1.023***	0.284***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.865***	0.97***	0.932***	0.984***	0.891***	0.972***	0.884***	0.977***	0.928***	0.983***	0.893***	0.952***
	(0.062)	(0.014)	(0.045)	(0.01)	(0.076)	(0.016)	(0.074)	(0.011)	(0.046)	(0.009)	(0.061)	(0.022)
Logli	1479.006		1483.435		1505.584		1499.248		1502.183		1515.702	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.556%***		-0.521%***		-0.452%***		-0.551%***		-0.363%***	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.000)	
f_1	0.309***	0.239***	0.255***	0.275***	0.251***	0.257***	0.271***	0.238***	0.248***	0.25***
	(0.06)	(0.015)	(0.058)	(0.018)	(0.039)	(0.018)	(0.06)	(0.015)	(0.057)	(0.018)
f_3	4.177	6.393***	4.126	6.275***	5.17***	2.792***	3.325	6.294***	1.507	5.482***
	(4.711)	(0.907)	(4.002)	(0.865)	(1.299)	(0.348)	(4.444)	(0.9)	(4.93)	(0.918)
f_4	-3.169	2.392***	-5.306*	2.342***	-1.406	1.917***	-2.511	2.369***		
	(2.818)	(0.606)	(2.784)	(0.586)	(1.563)	(0.502)	(2.572)	(0.606)		
f_6					0.048**	-0.006	0.062*	0.002	0.062*	0.004
					(0.022)	(0.005)	(0.035)	(0.005)	(0.036)	(0.006)
f_8									-5.424	4.231***
									(34.076)	(1.357)
f_1^2			1.885*	-1.857***						
			(1.133)	(0.623)						
f_3^2	1780.316	-1780.138***	1808.296	-1808.134***			1738.931	-1738.778***	1923.612	-1923.547***
	(3827.3)	(453.12)	(3088.312)	(437.5)			(3443.799)	(449.702)	(3921.362)	(477.846)
f_6^2									-0.091	-0.09*
									(0.481)	(0.052)
σ	1.343***	0.372***	1.239***	0.364***	1.002***	0.284***	1.288***	0.37***	1.247**	0.359***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.895***	0.981***	0.937***	0.985***	0.886***	0.95***	0.895***	0.98***	0.898***	0.976***
	(0.07)	(0.01)	(0.043)	(0.008)	(0.059)	(0.02)	(0.065)	(0.01)	(0.077)	(0.012)
Logli	1508.901		1513.767		1519.005		1510.931		1505.457	

Table 7 (Continued)

Panel F: Univariate estimates output of High Yield Fixed Income Fund Portfolio

Variable	(1) S_t=1	(1) S_t=2	(2) S_t=1	(2) S_t=2	(3) S_t=1	(3) S_t=2	(4) S_t=1	(4) S_t=2	(5) S_t=1	(5) S_t=2	(6) S_t=1	(6) S_t=2
Estim	0.023%		-0.023%		-0.033%		-0.055%		0.035%		0.258%***	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
f_1	0.279	0.512***	1.136**	0.402***	0.189	0.495***	0.379	0.428***	1.237**	0.406***	0.214	0.477***
	(0.323)	(0.073)	(0.546)	(0.089)	(0.223)	(0.075)	(0.353)	(0.092)	(0.521)	(0.084)	(0.196)	(0.072)
f_6					0.269***	0.074***	0.255***	0.068***	0.433***	0.053***	0.194***	0.038
					(0.048)	(0.025)	(0.049)	(0.024)	(0.057)	(0.02)	(0.058)	(0.027)
f_8											4.397	-38.359***
											(12.196)	(3.359)
f_1^2			-40.808*	7.564*			-8.917	4.924	-39.81**	5.258		
			(21.405)	(4.097)			(13.89)	(4.172)	(18.359)	(4.94)		
f_6^2									-0.179	-0.595***		
									(0.427)	(0.171)		
σ	2.787***	0.833***	2.651***	0.82***	1.88***	0.804***	1.868***	0.784***	1.273***	0.841***	1.466***	0.719***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.816***	0.954***	0.808***	0.952***	0.855***	0.959***	0.843***	0.953***	0.597***	0.92***	0.841***	0.941***
	(0.091)	(0.026)	(0.086)	(0.025)	(0.086)	(0.03)	(0.088)	(0.034)	(0.142)	(0.045)	(0.095)	(0.04)
Logli	565.073		568.686		587.217		588.095		590.858		603.534	

Variable	(7) S_t=1	(7) S_t=2	(8) S_t=1	(8) S_t=2	(9) S_t=1	(9) S_t=2	(10) S_t=1	(10) S_t=2	(11) S_t=1	(11) S_t=2
Estim	0.103%		0.303%		-0.506%**		0.054%		0.121%	
	(0.001)		(0.002)		(0.002)		(0.002)		(0.002)	
f_1	0.218	0.485***			0.379***	0.717***	-0.004	0.414***	0.363***	1.784***
	(0.213)	(0.069)			(0.073)	(0.197)	(0.101)	(0.067)	(0.061)	(0.424)
f_2					8.205***	-8.86***				
					(1.73)	(3.338)				
f_3			9.259	-12.906***			22.646***	-3.797	-10.152**	9.307**
			N/A	(4.324)			(3.367)	(5.626)	(4.583)	(4.384)
f_6	0.207***	0.048**	0.307	0.051*	0.09***	0.216***	0.219***	0.058***	0.078***	0.603***
	(0.048)	(0.021)	N/A	(0.027)	(0.018)	(0.052)	(0.054)	(0.02)	(0.016)	(0.068)
f_8	1.312	-11.456	9.793	-18.045**	-37.377***	52.591	2.211	-38.272***	-15.844**	13.858
	(13.322)	(10.491)	N/A	(7.972)	(3.995)	(33.681)	(14.553)	(3.148)	(7.306)	(36.068)
f_3^2			-5566.933	9666.981***			-9733.639***	4020.738	7711.419***	-7711.421***
			N/A	(1566.799)			(147.011)	(2751.285)	(2147.128)	(67.104)
f_8^2	12720.268***	-12720.19**	49267.139	-10367.928***					-9887.314***	9887.311***
	(240.761)	(4913.81)	N/A	(3698.732)					(3671.68)	(2.795)
σ	1.577***	0.77***	1.19**	0.887***	1.009***	0.57**	1.562***	0.71***	0.881***	0.711*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.845***	0.954***	0.107	0.813***	0.976***	0.788***	0.808***	0.948***	0.981***	0.592***
	(0.087)	(0.033)	(0.306)	(0.119)	(0.018)	(0.128)	(0.102)	(0.03)	(0.014)	(0.2)
Logli	599.606		591.41		594.479		608.638		608.869	

Table 8: Estimates of Univariate Regime-Switching Model with Timing Coefficients not State-Dependent

This table reports the estimation output for the regime-switching model $r_{p,t} = a_{S_t,p} + \sum_{i=1}^{I} \beta_{i,s_t} f_{i,t} + \sum_{j=1}^{J} \Lambda_j f_{j,t}^2 + \varepsilon_{p,t}$

where $a_{S_t,p}$ estimates fund manager's alpha performance in state s_t, β_{i,s_t} is risk exposure to market factor $f_{i,t}$ in state s_t, Λ_j isloading on quadratic market factor $f_{j,t}^2$, and $\varepsilon_{p,t} \sim N(0, \sigma_{S_t}^2)$ is the return innovation of portfolio. Switches of latent variable between two states, s_t , are governed by a transition probability which is a realization of first-order Markov chain on a constant transition probability. We consider a model with k=2, I up to four, and J up two. The sample comprises monthly excess returns of six value-weighted portfolios on 30-day TB rates: Canadian Fixed Income Funds (CFI), Canadian Inflation Protected Fixed Income Funds (CIPFI), Canadian Long Term Fixed Income Funds (CLTFI), Canadian Money Market Funds (CMM), Canadian Short Term Fixed Income Funds (CSTFI), and High Yield Fixed Income Funds (HYFI). Market factors are aggregate bond index (f_1), default premium (f_2), term premium (f_3), mortgage spread (f_4), inflation changes (f_5), TSX-300 (f_6), banker acceptance rate (f_7), stock market volatility (f_8). Standard errors of coefficients are reported in parenthesis under estimates of coefficients. Estim is the intercepts, σ is the percentage of standard deviation of residues, logli denotes the log-likelihood, and P reports the persistent transition probability p_{11} in state 1 and p_{22} in state 2. N/A indicate we are able to not able to obtain the estimates. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level, respectively.

Panel A: Univariate estimates output of Canadian Fixed-income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.668%***	-0.376%***	-0.611%***	-0.385%***	-0.887%***	-0.788%***	-0.931%***	-0.754%***	-0.93%***	-0.756%***	-1.075%***	-0.759%***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	(0.000)
f_1	0.795***	0.964***	-0.006***	0.991***	0.636***	0.887***	-0.009***	0.945***	-76.249	0.945***	0.684***	0.936***
	(0.019)	(0.011)	(0.001)	(0.016)	(0.025)	(0.012)	(0.001)	(0.01)	(270.967)	(0.01)	(0.02)	(0.009)
f_3					4.565***	3.483***	0.7***	3.18***	-0.009***	3.314***	4.031***	3.184***
					(1.191)	(0.304)	(0.022)	(0.209)	(0.001)	(0.518)	(0.977)	(0.215)
f_5											0.096	-0.023
											(0.171)	(0.041)
f_1^2			-1.195***				-0.579**		-0.578**			
			(0.364)				(0.284)		(0.284)			
f_3^2									-76.249			
									(270.967)			
σ	0.571***	0.171***	0.558***	0.181***	0.406***	0.334***	0.498***	0.248***	0.497***	0.248***	0.486***	0.25***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.988***	0.984***	0.981***	0.98***	0.000	0.863***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***
	(0.009)	(0.009)	(0.012)	(0.01)	N/A	(0.041)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)
Logli	1659.203		1662.417		1596.949		1708.336		1708.212		1706.556	

Table 8 (Continued)

Panel A: Univariate estimates output of Canadian Fixed-income Fund Portfolio

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	0.245%***	-0.678%***	-1.231%***	-0.807%***	-1.323%***	-0.75%***	-1.26%***	-0.739%***	-1.296%***	-1.064%***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.001)
f_1	2.45***	0.842***	-273.597	0.944***	0.679***	0.936***	-0.013***	0.945***	-1453.615***	0.935***
	(0.000)	(0.012)	(280.204)	(0.01)	(0.02)	(0.009)	(0.002)	(0.01)	(286.358)	(0.01)
f_2			-0.012***	0.821	4.524	-0.09	0.695***	-0.069	-0.013***	4.623***
			(0.002)	(0.927)	(3.129)	(0.272)	(0.022)	(0.259)	(0.002)	(0.947)
f_3	-0.681***	3.143***	0.694***	3.201***	3.973***	3.215***	5.081	3.177***	0.684***	3.177***
	(0.000)	(0.315)	(0.022)	(0.229)	(0.961)	(0.235)	(3.207)	(0.231)	(0.023)	(0.228)
f_5	-3.139***	-0.126**			0.085	-0.025	3.532***	-0.026		
	(0.000)	(0.054)			(0.168)	(0.041)	(1.005)	(0.041)		
f_6									6.94**	0.01***
									(3.242)	(0.003)
f_1^2	-1.268***		-0.563**				-0.595**		-0.305	
	(0.279)		(0.283)				(0.284)		(0.284)	
f_2^2			-273.597						-1453.615***	
			(280.204)						(286.358)	
σ	1.658***	0.397***	0.488***	0.246***	0.478***	0.25***	0.489***	0.247***	0.484***	0.245***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.766***	0.999***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)
Logli	1577.266		1711.461		1707.641		1709.86		1713.974	

Table 8 (Continued)

Panel B: Univariate estimates output of Canadian Inflation Protected Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.264%*	0.259%***	-1.73%*	0.024%	-1.036%	-0.279%**	-0.074%	3.981%***	-0.119%	0.098%***	0.013%	-0.2%***
	(0.001)	(0.000)	(0.009)	(0.002)	N/A	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	(0.000)
f_1	1.06***	-1.306***	-0.017*	0.692***	-3.087	0.971***	0.886***	0.04***	0.992***	-0.77***	1.035***	-0.065*
	(0.104)	(0.000)	(0.009)	(0.157)	(66.473)	(0.102)	(0.094)	(0.000)	(0.11)	(0.005)	(0.106)	(0.036)
f_4											-6.905**	21.674***
											(2.76)	(0.597)
f_6					-0.196	0.097***	0.04*	0.292***	0.072***	0.001***	0.092***	-0.088***
					N/A	(0.025)	(0.023)	(0.000)	(0.027)	(0.000)	(0.024)	(0.018)
f_1^2			1.706						1.44***			
			(7.802)						(0.179)			
f_6^2							-0.714***		-0.77***			
							(0.000)		(0.005)			
σ	1.708***	0***	2.427**	1.373***	2.481	1.667***	1.518***	0.000	1.675***	0.016**	1.602***	0.067
	(0.000)	(0.000)	(0.000)	(0.000)	(0.064)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.996***	0.753	0.839***	0.971***	0.999	0.999***	0.985***	0.000	0.96***	0.385***	0.98***	0.381
	(0.000)	N/A	(0.127)	(0.026)	N/A	(0.000)	(0.009)	(0.000)	(0.016)	(0.147)	(0.013)	(0.245)
Logli	570.278		557.573		547.735		607.306		569.075		557.574	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	0.312%**	3.327%***	-0.347%**	-2.672%***	0.247%	3.532%	0.047%	3.097%***	-0.508%	0.314%
	(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	N/A	(0.002)	(0.001)	(0.003)	(0.002)
f_1	0.885***	0.033***	1.012***	-0.479***	0.852***	1.951	0.9***	0.031***	-0.77***	0.483***
	(0.093)	(0.000)	(0.102)	(0.000)	(0.093)	N/A	(0.092)	(0.001)	(0.215)	(0.109)
f_4	-7.73	0.66***			-7.654***	6.743	-6.329***	1.317***	-0.005	-3.112
	N/A	(0.000)			(2.212)	N/A	(2.078)	(0.016)	(0.003)	(2.424)
f_5			0.298	-0.027***			0.644**	5.494***	1.493***	-0.013
			(0.335)	(0.000)			(0.309)	(0.557)	(0.182)	(0.38)
f_6	0.033	6.037***	0.063**	0.84***	0.07***	0.328	0.039*	-1.719***	-7.163*	-0.01
	(0.023)	(0.000)	(0.024)	(0.000)	(0.023)	N/A	(0.023)	(0.077)	(3.771)	(0.026)
f_7					-0.041					
					(0.051)					
f_5^2			85.717***						159.996***	
			(0.000)						(53.797)	
f_6^2	-0.734***		-0.479***				-0.634***		-0.77***	
	(0.000)		(0.000)				(0.038)		(0.215)	
σ	1.494***	0.000	1.602***	0***	1.483***	0***	1.421***	0.054*	1.667***	1.201***
	(0.000)	N/A	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.98***	0.000	0.841***	0.6*	0.979***	0***	0.951***	0.000	0.961***	0.974***
	(0.01)	(0.000)	(0.028)	(0.361)	(0.01)	(0.000)	(0.018)	(0.000)	(0.029)	(0.02)
Logli	613.294		581.641		597.668		579.447		574.677	

Table 8 (Continued)

Panel C: Univariate estimates output of Canadian Long Term Fixed-income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.519%***	-5.084%	-0.525%***	1.177%***	-1.288%	-0.31%***	-169.261%***	-0.333%***	-879.534%***	-0.3%***	-0.177%*	0.639%
	(0.001)	(1.161)	(0.001)	(0.000)	N/A	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.262)
f_1	1.835***	-7.03	1.803***	0.012***	-9.17	1.826***	-1.693***	1.782***	-1687.651	1.783***	1.816***	0.5
	(0.06)	(212.322)	(0.06)	(0.000)	N/A	(0.057)	(0.000)	(0.072)	(1652.672)	(0.072)	(0.055)	N/A
f_4					59.354	-4.632***	30.357***	-4.801***	-8.795***	-3.701**	-3.636***	-1.57
					N/A	(1.033)	(0.000)	(1.031)	(0.000)	(1.489)	(1.064)	N/A
f_7											-0.074***	
											(0.026)	
f_1^2			2.547***				4.074		4.314			
			(0.000)				(4.203)		(4.197)			
f_4^2									-1687.651			
									(1652.672)			
σ	0.758***	0.742	0.748***	0***	6.64	0.711***	6.537***	0.709***	2.701***	0.706***	0.694***	0.015
	(0.000)	(0.034)	(0.000)	(0.000)	N/A	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	N/A
P	0.999***	0.996	0.999***	0.166***	0.841	0.999***	0.999***	0.999***	0.999***	0.999***	0.999***	0.042
	(0.000)	(1.084)	(0.000)	(0.000)	(8.018)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	N/A
Logli	529.136		552.473		539.043		539.517		540.02		542.745	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	173.032%***	-0.334%***	-413.096%***	-0.362%***	0.025%	-0.212%***	-0.108%	-0.285%	0.279%	0.52%
	(0.000)	(0.001)	(0.000)	(0.001)	(0.002)	(0.000)	(0.002)	(0.055)	(0.068)	(0.003)
f_1	1.73***	1.801***	-0.814**	1.75***	1.824***	-8.858***	1.806***	-0.003	-0.983***	1.808***
	(0.000)	(0.055)	(0.37)	(0.07)	(0.055)	(0.000)	(0.054)	(0.055)	(0.366)	(0.054)
f_2					-1.693	-4.027***	-2.024*	-3.627	0.003	-10.839**
					(1.136)	(0.000)	(1.105)	N/A	(0.068)	(4.498)
f_4	-14.541***	-4.347***	-4.131***	-4.379***	-3.738***	1.051***	-4.333***	10.214	-17.55	-4.94***
	(0.000)	(1.076)	(0.000)	(1.071)	(1.057)	(0.000)	(1.055)	N/A	(112.571)	(1.07)
f_7	0.047		0.045		-0.061**		0.07		0.096	
	(0.06)		(0.06)		(0.028)		(0.061)		(0.061)	
f_1^2			4.671							
			(4.041)							
f_2^2									2587.991*	
									(1323.182)	
f_7^2	-0.818**		-0.814**				-0.868**		-0.983***	
	(0.371)		(0.37)				(0.366)		(0.366)	
σ	2.761***	0.683***	3.717***	0.68***	0.687***	0.005***	0.667***	0.127	3.088	0.664***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.235)	(0.000)
P	0.999***	0.999***	0.999***	0.999***	0.999***	0.299***	0.999***	0.981	0.999***	0.999***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(1.287)	(0.000)	(0.000)
Logli	545.145		545.81		544.24		547.205		549.403	

Table 8 (Continued)

Panel D: Univariate estimates output of Canadian Money Market Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.074%***	-0.051%***	0.077%	-0.06%***	-0.086%***	-0.078%***	-0.094%***	-0.085%***	-0.086%***	-0.084%***	-0.087%***	-0.076%***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
f_3	0.304**	0.148***	0.001	0.255***	0.342***	0.179***	-0.001***	0.207***	-0.046***	0.194	0.217**	0.163***
	(0.134)	(0.021)	(0.001)	(0.071)	(0.064)	(0.034)	(0.000)	(0.023)	(0.009)	(0.14)	(0.108)	(0.022)
f_7					0.013***		0.016***		0.018***		0.013***	
					(0.001)		(0.002)		(0.001)		(0.001)	
f_8											-0.135	
											(0.124)	
f_3^2			-29.087						-7.422			
			(39.054)						(68.063)			
f_7^2							-0.04***		-0.046***			
							(0.01)		(0.009)			
σ	0.066***	0.019***	0.044	0.041***	0.06***	0.015***	0.069***	0.017***	0.057***	0.014***	0.056***	0.015***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.048	0.963***	0.11	0.989***	0.926***	0.928***	0.889***	0.941***	0.956***	0.947***	0.052***	0.967***
	N/A	(0.022)	(0.361)	(0.008)	(0.032)	(0.023)	(0.039)	(0.02)	(0.024)	(0.022)	(0.003)	(0.017)
Logli	2339.511		2400.895		2530.037		2530.464		2535.536		2330.291	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.108%***	-0.065%***	-0.073%***	-0.089%***	-0.061%***	-0.078%***	-0.074%***	-0.085%***	-0.093%***	-0.107%***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
f_2									-8.597	0.476***
									(117.384)	(0.107)
f_3	-0.001***	-0.157**	-0.045***	0.306***	0.149	0.232***	-0.001***	0.244***	-0.001***	0.168
	(0.000)	(0.065)	(0.01)	(0.068)	(0.092)	(0.021)	(0.000)	(0.019)	(0.000)	(0.144)
f_6					0.001	0.001***	0.231**	0.001***		
					(0.001)	(0.000)	(0.099)	(0.000)		
f_7	0.01***		0.014***		0.009***		0.01***		0.01***	
	(0.001)		(0.001)		(0.001)		(0.001)		(0.001)	
f_8	-0.034		0.278***		0.275***		0.749***		-0.147	
	(0.073)		(0.074)		(0.079)		(0.136)		(0.117)	
f_2^2									-119.568***	
									(27.768)	
f_3^2	188.806***		-26.862						-8.597	
	(31.64)		(33.708)						(117.384)	
f_7^2			-0.045***							
			(0.01)							
f_8^2							-353.376***			
							(73.613)			
σ	0.065***	0.018***	0.064***	0.02***	0.065***	0.02***	0.069***	0.019***	0.063***	0.015***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.038***	0.982***	0.963***	0.974***	0.962***	0.974***	0.967***	0.984***	0.9***	0.927***
	(0.014)	(0.015)	(0.023)	(0.014)	(0.024)	(0.013)	(0.022)	(0.011)	(0.042)	(0.034)
Logli	2378.546		2528.871		2524.72		2534.334		2548.494	

Table 8 (Continued)

Panel E: Univariate estimates output of Canadian Short Term Fixed-income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.439%**	-0.076%***	-0.322%	-0.065%**	-0.697%***	-0.281%***	-0.683%***	-0.258%***	-0.712%***	-0.29%***	-0.804%**	-0.466%***
	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.002)	(0.000)	(0.003)	(0.001)
f_1	0.314***	0.257***	-0.003	0.278***	0.279***	0.263***	-0.007***	0.267***	-416.631	0.271***	0.275***	0.263***
	(0.056)	(0.017)	(0.002)	(0.02)	(0.039)	(0.023)	(0.002)	(0.019)	(413.728)	(0.019)	(0.037)	(0.02)
f_3					6.891***	1.983***	0.278***	0.906	-0.007***	2.877***	7.125***	2.832***
					(1.779)	(0.308)	(0.037)	(0.949)	(0.002)	(0.801)	(1.986)	(0.36)
f_4											1.427	1.955***
											(3.123)	(0.51)
f_1^2			-1.129*						-0.812			
			(0.684)						(0.596)			
f_3^2							553.643		-416.631			
							(463.694)		(413.728)			
σ	1.341***	0.378***	1.37***	0.38***	1.028***	0.302***	1.018***	0.292***	1.188***	0.347***	1.017***	0.285***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.861***	0.97***	0.884***	0.975***	0.901***	0.957***	0.894***	0.952***	0.919***	0.977***	0.896***	0.953***
	(0.063)	(0.013)	(0.063)	(0.013)	(0.063)	(0.021)	(0.06)	(0.021)	(0.055)	(0.012)	(0.061)	(0.022)
Logli	1481.008		1482.814		1508.76		1508.488		1510.016		1516.218	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.906%**	-0.494%***	-0.708%	-0.488%***	-0.752%**	-0.437%***	-0.76%**	-0.451%***	-0.823%***	-0.312%***
	(0.004)	(0.001)	(0.005)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.002)	(0.000)
f_1	-0.009**	0.251***	-212.015	0.265***	0.254***	0.255***	-0.008**	0.253***	-0.112**	0.265***
	(0.004)	(0.019)	(403.619)	(0.018)	(0.04)	(0.017)	(0.003)	(0.018)	(0.047)	(0.02)
f_3	0.283***	3.701***	-0.007	3.483***	6.507***	2.727***	0.254***	3.221***	-0.008***	2.879***
	(0.047)	(0.961)	(0.005)	(0.836)	(1.989)	(0.355)	(0.04)	(1.103)	(0.002)	(0.927)
f_4	8.197***	2.134***	0.315***	2.312***	1.079	1.839***	6.801***	1.867***		
	(2.428)	(0.613)	(0.053)	(0.628)	(3.069)	(0.51)	(2.11)	(0.526)		
f_6					0.046**	-0.007	1.166	-0.006	0.24***	0.001
					(0.022)	(0.005)	(3.112)	(0.005)	(0.037)	(0.005)
f_8									3.988***	
									(1.228)	
f_1^2			-0.977							
			(0.598)							
f_3^2	-372.682		-212.015				-249.95		-550.824	
	(441.938)		(403.619)				(514.939)		(542.44)	
f_6^2									-0.112**	
									(0.047)	
σ	1.112**	0.33***	1.209***	0.346***	0.999***	0.286***	1***	0.289***	0.953***	0.31***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.916***	0.973***	0.933***	0.982***	0.884***	0.95***	0.889***	0.953***	0.964***	0.98***

	(0.091)	(0.019)	(0.05)	(0.012)	(0.059)	(0.02)	(0.059)	(0.021)	(0.06)	(0.022)
Logli	1516.154		1517.252		1519.423		1518.968		1517.218	

Table 8 (Continued)

Panel F: Univariate estimates output of High Yield Fixed Income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.37%	0.04%	-0.401%	-0.006%	0.347%	-0.069%	-0.113%	0.071%***	0.551%	-0.028%	0.756%**	0.18%*
	(0.006)	(0.001)	(0.006)	(0.001)	(0.004)	(0.001)	(0.001)	(0.000)	(0.004)	(0.001)	(0.004)	(0.001)
f_1	0.418	0.505***	-0.004	0.432***	0.067	0.503***	0.353***	0.001***	-0.525***	0.458***	0.135	0.466***
	(0.381)	(0.074)	(0.006)	(0.089)	(0.252)	(0.077)	(0.084)	(0.000)	(0.159)	(0.086)	(0.216)	(0.07)
f_6					0.279***	0.075***	0.167***	-0.402***	0.006	0.069***	0.198***	0.054**
					(0.048)	(0.024)	(0.018)	(0.001)	(0.004)	(0.019)	(0.057)	(0.023)
f_8											-36.32***	
											(3.243)	
f_1^2			5.714				8.109***		4.562			
			(4.143)				(0.026)		(4)			
f_6^2									-0.525***			
									(0.159)			
σ	2.783***	0.834***	2.837***	0.822***	1.848***	0.807***	1.198***	0.001*	1.808***	0.768***	1.4***	0.746***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.807***	0.953***	0.806***	0.953***	0.869***	0.963***	0.977***	0.265	0.835***	0.952***	0.849***	0.953***
	(0.095)	(0.027)	(0.091)	(0.026)	(0.076)	(0.025)	(0.011)	(0.179)	(0.086)	(0.028)	(0.086)	(0.027)
Logli	565.335		566.281		587.796		577.139		590.985		604.565	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	0.221%	0.43%***	0.269%***	-0.134%	-1.952%***	-0.618%***	0.335%	-0.677%**	0.141%	0.673%**
	(0.003)	(0.001)	(0.008)	(0.003)	(0.000)	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)
f_1	0.002	0.499***			0.697***	0.387***	0.358***	-0.007**	-13142.595**	0.477***
	(0.003)	(0.061)			(0.000)	(0.07)	(0.063)	(0.003)	(5687.688)	(0.056)
f_2					38.96***	7.848***				
					(0.000)	(1.665)				
f_3			-13991.67**	-3.552			-13.915***	2.862***	0.001	-10.088*
			(6083.39)	(8.767)			(5.087)	(0.184)	(0.004)	(5.448)
f_6	0.167	0.042**	0.029***	0.108***	-0.692***	0.104***	0.091***	12.957***	0.215	0.042***
	(0.152)	(0.016)	(0.008)	(0.024)	(0.000)	(0.018)	(0.016)	(4.441)	(0.138)	(0.016)
f_8	-74.364***		-7.365		-34.65***		-32.241***		-83.367***	
	(9.807)		(12.603)		(4.059)		(3.337)		(10.944)	
f_3^2			4733.143				9475.902***		6157.217**	
			(4804.924)				(2365.095)		(2458.906)	
f_8^2	-28736.725***		-13991.67**						-13142.595**	
	(6458.518)		(6083.39)						(5687.688)	
σ	1.325***	0.618***	0.94	0.929***	4.361***	1.053***	0.911***	0.184	1.223***	0.535***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.877***	0.929***	0.358	0.958***	0.999***	0.999***	0.973***	0.177	0.902***	0.923***
	(0.055)	(0.037)	(0.42)	(0.028)	(0.000)	(0.000)	(0.015)	(0.199)	(0.05)	(0.04)
Logli	609.802		590.469		588.656		606.712		621.694	

Table 9: Estimates of Univariate Regime-Switching Model with Intercept, Betas and Timing Coefficients Not State-Dependent

This table reports the estimation output for the regime-switching model $r_{p,t} = a_p + \sum_{i=1}^{I} \beta_i f_{i,t} + \sum_{j=1}^{J} \Lambda_j f_{j,t}^2 + \varepsilon_{p,t}$
where a_p estimate fund manager's performance, β_j and Λ_j are the linear risk exposure to market factor and its square $f_{j,t}$ and $f_{j,t}^2$ sportively, and $\varepsilon_{p,t} \sim N(0, \sigma_{S_t}^2)$ is the return innovation of portfolio. Switches of state variable between two states, s_t , are governed by a transition probability which is a realization of first-order Markov chain on a constant transition probability. We consider a model with k=2, I up to four, and J up to two. The sample comprises monthly excess returns of six value-weighted portfolios on 30-day TB rates: Canadian Fixed-Income Funds (CFI), Canadian Inflation Protected Fixed-Income Funds (CIPFI), Canadian Long Term Fixed-Income Funds (CLTFI), Canadian Money Market Funds (CMM), Canadian Short Term Fixed Income Funds (CSTFI), and High Yield Fixed-Income Funds (HYFI). Market factors aggregate bond index (f_1), default premium (f_2), term premium (f_3), mortgage spread (f_4), inflation changes (f_5), TSX-300 (f_6), banker acceptance rate (f_7), stock market volatility (f_8). Standard errors of coefficients are reported in parenthesis under estimates of coefficients. Estim is the intercepts, σ is the percentage of standard deviation of residues, logli denotes the log-likelihood, and P reports the persistent transition probability p_{11} in state 1 and p_{22} in state 2. N/A indicate we are able to not able to obtain the estimates. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

Panel A: Univariate estimates output of Canadian Fixed-income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.452%***		-0.366%***		-0.765%***		-0.737%***		-0.731%***		-0.753%***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
f_1	0.939***		0.953***		0.922***		0.941***		0.941***		0.922***	
	(-0.012)		(-0.013)		(-0.01)		(-0.011)		(-0.011)		(-0.01)	
f_3					3.248***		3.171***		2.811***		3.204***	
					(-0.21)		(-0.208)		(-0.518)		(-0.215)	
f_5											-0.039	
											(-0.04)	
f_1^2			-1.842***				-1.245***		-1.247***			
			(-0.401)				(-0.32)		(-0.32)			
f_3^2									207.046			
									(-272.803)			
σ	0.93***	0.236***	0.697***	0.178***	0.99***	0.251***	0.94***	0.248***	0.941***	0.248***	0.984***	0.251***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.957***	0.979***	0.991***	0.985***	0.999	0.997***	0.999***	0.997***	0.999***	0.997***	0.999	0.997***
	(-0.023)	(0.01)	(-0.009)	(0.01)	N/A	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)	N/A	(0.003)
Logli	1596.747		1609.253		1660.247		1667.691		1667.974		1660.717	

Table 9 (Continued)

Variable	(7) S_t=1	(7) S_t=2	(8) S_t=1	(8) S_t=2	(9) S_t=1	(9) S_t=2	(10) S_t=1	(10) S_t=2	(11) S_t=1	(11) S_t=2
Estim	-0.725%***		-0.893%***		-0.752%***		-0.728%***		-0.906%***	
	(0.000)		(-0.001)		(0.000)		(-0.001)		(-0.001)	
f_1	0.941***		0.938***		0.922***		0.941***		0.933***	
	(-0.011)		(-0.011)		(-0.01)		(-0.011)		(-0.011)	
f_2			2.31**		-0.008		0.029		2.445***	
			(-0.921)		(-0.076)		(-0.506)		(-0.911)	
f_3	3.127***		3.164***		3.207***		3.116***		3.131***	
	(-0.213)		(-0.227)		(-0.216)		(-0.28)		(-0.224)	
f_5	-0.039				-0.039		-0.038			
	(-0.04)				(-0.04)		(-0.04)			
f_6									0.009***	
									(-0.003)	
f_1^2	-1.244***		-1.096***				-1.247***		-0.971***	
	(-0.319)		(-0.323)				(-0.32)		(-0.323)	
f_2^2			-711.625**						-741.208***	
			(-279.828)						(-276.577)	
σ	0.935***	0.248***	0.926***	0.246***	0.984***	0.251***	0.934***	0.248***	0.934***	0.243***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***	0.999***	0.997***
	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.003)
Logli	1668.17		1670.938		1660.718		1668.176		1674.974	

Table 9 (Continued)

Panel B: Univariate estimates output of Canadian Inflation Protected Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.154%		-0.163%		-0.186%		-0.042%		-0.045%		0.089%	
	(-0.001)		(-0.001)		(-0.001)		(-0.002)		(-0.002)		(-0.002)	
f_1	0.899***		0.873***		0.883***		0.863***		0.808***		0.884***	
	(-0.095)		(-0.129)		(-0.095)		(-0.101)		(-0.144)		(-0.094)	
f_4											-5.645***	
											(-2.088)	
f_6					0.061**		0.043*		0.043		0.059**	
					(-0.025)		(-0.026)		(-0.026)		(-0.024)	
f_1^2			1.551						2.948			
			(-5.27)						(-5.563)			
f_6^2							-0.549**		-0.57**			
							(-0.255)		(-0.255)			
σ	3.996*	1.482***	4.01*	1.481***	3.454*	1.456***	3.042*	1.418***	2.968*	1.402***	3.447*	1.428***
	(-0.001)	(0.000)	(-0.001)	(0.000)	(-0.001)	(0.000)	(-0.001)	(0.000)	(0.000)	(0.000)	(-0.001)	(0.000)
P	0.872***	0.993***	0.872***	0.993***	0.873***	0.991***	0.876***	0.987***	0.882***	0.986***	0.871***	0.991***
	(-0.12)	(0.008)	(-0.12)	(0.008)	(-0.115)	(0.01)	(-0.105)	(0.016)	(-0.102)	(0.016)	(-0.118)	(0.011)
Logli	554.364		554.414		557.403		559.665		559.807		560.961	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	0.169%		-0.26%		0.123%		0.078%		-0.043%	
	(-0.002)		(-0.002)		(-0.002)		(-0.002)		(-0.002)	
f_1	0.869***		0.905***		0.885***		0.881***		0.907***	
	(-0.097)		(-0.095)		(-0.094)		(-0.099)		(-0.094)	
f_4	-4.984**				-5.392**		-4.949**		-4.91**	
	(-2.111)				(-2.21)		(-2.106)		(-2.086)	
f_5			0.205				0.529		0.195	
			(-0.369)				(-0.327)		(-0.366)	
f_6	0.044*		0.034		0.06**		0.041		0.035	
	(-0.026)		(-0.026)		(-0.024)		(-0.025)		(-0.025)	
f_7					-0.02					
					(-0.063)					
f_5^2			115.609*						116.452*	
			(-61.538)						(-60.444)	
f_6^2	-0.441*		-0.561**				-0.452*		-0.461*	
	(-0.255)		(-0.254)				(-0.252)		(-0.254)	
σ	3.165*	1.407***	3.38*	1.422***	3.353*	1.425***	3.121	1.382***	3.462*	1.402***
	(-0.001)	(0.000)	(-0.001)	(0.000)	(-0.001)	(0.000)	(-0.001)	(0.000)	(-0.001)	(0.000)
P	0.87***	0.989***	0.853***	0.99***	0.871***	0.99***	0.843***	0.985***	0.846***	0.99***
	(-0.112)	(0.015)	(-0.129)	(0.011)	(-0.116)	(0.012)	(-0.129)	(0.021)	(-0.137)	(0.012)
Logli	562.438		562.61		561.012		563.731		565.356	

Table 9 (Continued)

Panel C: Univariate estimates output of Canadian Long Term Fixed-income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.502%***		-0.528%***		-0.279%***		-0.315%***		-0.28%***		-0.159%*	
	(-0.001)		(-0.001)		(-0.001)		(-0.001)		(-0.001)		(-0.001)	
f_1	1.826***		1.782***		1.811***		1.738***		1.74***		1.809***	
	(-0.06)		(-0.078)		(-0.06)		(-0.073)		(-0.072)		(-0.057)	
f_4					-4.651***		-4.751***		-3.65***		-3.891***	
					(-0.983)		(-0.97)		(-1.338)		(-1.051)	
f_7											-0.07**	
											(-0.028)	
f_1^2			3.798				6.753		7.28*			
			(-4.432)				(-4.298)		(-4.309)			
f_4^2									-1659.208			
									(-1434.29)			
σ	0.939***	0.558**	0.947***	0.555**	0.918**	0.523**	0.971**	0.521***	0.976**	0.508***	0.864**	0.575*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.568	0.629	0.604*	0.676**	0.669*	0.774***	0.648**	0.815***	0.664**	0.821***	0.645	0.8***
	(-0.385)	(0.417)	(-0.363)	(0.322)	(-0.374)	(0.172)	(-0.277)	(0.142)	(-0.256)	(0.122)	(-0.435)	(0.285)
Logli	530.839		531.206		541.396		542.573		543.452		543.949	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.348%***		-0.385%***		0.062%		-0.109%		0.516%	
	(-0.001)		(-0.001)		(-0.002)		(-0.002)		(-0.004)	
f_1	1.797***		1.722***		1.826***		1.817***		1.807***	
	(-0.057)		(-0.07)		(-0.055)		(-0.05)		(-0.057)	
f_2					-1.979*		-2.564**		-11.245**	
					(-1.115)		(-1.165)		(-4.625)	
f_4	-4.448***		-4.535***		-3.916***		-5.031***		-5.018***	
	(-1.027)		(-1.015)		(-1.041)		(-0.988)		(-1.034)	
f_7	0.069		0.064		-0.057**		0.118**		0.12**	
	(-0.056)		(-0.054)		(-0.027)		(-0.058)		(-0.056)	
f_1^2			7.488*							
			(-3.997)							
f_2^2									2760.008**	
									(-1322.028)	
f_7^2	-0.925***		-0.913***				-1.097***		-1.103***	
	(-0.328)		(-0.311)				(-0.366)		(-0.314)	
σ	0.881**	0.506**	0.915**	0.491**	1.016	0.683***	0.741***	0.332***	0.825**	0.439
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.679**	0.782***	0.709***	0.828***	0.55	0.999	0.964***	0.87***	0.77**	0.761***
	(-0.296)	(0.173)	(-0.238)	(0.138)	N/A	N/A	(-0.032)	(0.094)	(-0.325)	(0.16)
Logli	547.319		548.957		545.21		549.695		552.047	

Table 9 (Continued)

Panel D: Univariate estimates output of Canadian Money Market Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.06%***		-0.061%***		-0.072%***		-0.082%***		-0.082%***		-0.083%***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
f_3	0.235***		0.26***		0.208***		0.219***		0.237***		0.252***	
	(-0.036)		(-0.079)		(-0.022)		(-0.022)		(-0.06)		(-0.022)	
f_7					0.007***		0.013***		0.013***		0.01***	
					(-0.001)		(-0.002)		(-0.002)		(-0.001)	
f_8											0.359***	
											(-0.105)	
f_3^2			-15.434						-7.423			
			(-43.369)						(-34.195)			
f_7^2							-0.027**		-0.024**			
							(-0.013)		(-0.012)			
σ	0.053***	0.043***	0.053***	0.043***	0.063***	0.016***	0.072***	0.017***	0.068***	0.018***	0.074***	0.02***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.841***	0.841***	0.841***	0.841***	0.956***	0.951***	0.911***	0.923***	0.935***	0.95***	0.946***	0.99***
	(-0.14)	(0.087)	(-0.14)	(0.087)	(-0.021)	(0.019)	(-0.035)	(0.024)	(-0.031)	(0.022)	(-0.03)	(0.01)
Logli	2406.863		2406.864		2520.571		2519.192		2519.99		2513.29	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.064%***		-0.078%***		-0.081%***		-0.084%***		-0.108%***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)	
f_2									0.462***	
									(-0.084)	
f_3	-0.102		0.263***		0.247***		0.248***		0.202***	
	(-0.074)		(-0.08)		(-0.037)		(-0.037)		(-0.06)	
f_6					0.001**		0.001**			
					(-0.001)		(-0.001)			
f_7	0.007***		0.009***		0.006***		0.006***		0.009***	
	(-0.001)		(-0.001)		(-0.001)		(-0.001)		(-0.001)	
f_8	0.178*		0.219**		0.506***		0.899***		-0.033	
	(-0.1)		(-0.093)		(-0.162)		(-0.299)		(-0.081)	
f_2^2									-119.565***	
									(-24.831)	
f_3^2	166.438***		-26.873						-8.607	
	(-36.312)		(-47.323)						(-32.458)	
f_7^2			-0.022*							
			(-0.011)							
f_8^2							-252.07			
							(-162.761)			
σ	0.066***	0.016***	0.062***	0.016***	0.053***	0.043***	0.053***	0.043***	0.07***	0.017***

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.964***	0.965***	0.939***	0.943***	0.841***	0.841***	0.841***	0.841***	0.898***	0.937***
	(-0.018)	(0.016)	(-0.027)	(0.022)	(-0.173)	(0.095)	(-0.172)	(0.094)	(-0.04)	(0.021)
Logli	2528.793		2521.454		2433.361		2434.649		2537.778	

Table 9 (Continued)

Panel E: Univariate estimates output of Canadian Short Term Fixed-income Fund Portfolio

	(1)		(2)		(3)		(4)		(5)		(6)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.087%***		-0.072%***		-0.306%***		-0.358%***		-0.339%***		-0.504%***	
	(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(-0.001)	
f_1	0.263***		0.288***		0.26***		0.254***		0.273***		0.256***	
	(-0.016)		(-0.019)		(-0.015)		(-0.016)		(-0.018)		(-0.018)	
f_3					2.323***		5.502***		5.479***		3.21***	
					(-0.305)		(-0.846)		(-0.842)		(-0.399)	
f_4											2.185***	
											(-0.603)	
f_1^2			-1.395**						-0.99*			
			(-0.688)						(-0.56)			
f_3^2							-1794.658***		-1828.761***			
							(-443.976)		(-442.561)			
σ	1.371***	0.376***	1.39***	0.38***	1.268***	0.351***	1.277***	0.368***	1.291***	0.367***	1.251***	0.339***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.865***	0.97***	0.897***	0.977***	0.89***	0.973***	0.9***	0.978***	0.918***	0.981***	0.883***	0.97***
	(-0.062)	(0.014)	(-0.062)	(0.013)	(-0.074)	(0.015)	(-0.067)	(0.012)	(-0.056)	(0.011)	(-0.092)	(0.025)
Logli	1478.899		1481.664		1504.873		1501.143		1502.537		1512.022	

	(7)		(8)		(9)		(10)		(11)	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.561%***		-0.544%***		-0.508%***		-0.562%***		-0.365%***	
	(-0.001)		(-0.001)		(-0.001)		(-0.001)		(0.000)	
f_1	0.246***		0.268***		0.254***		0.245***		0.265***	
	(-0.015)		(-0.018)		(-0.018)		(-0.015)		(-0.015)	
f_3	6.418***		6.39***		3.233***		6.345***		5.363***	
	(-0.882)		(-0.855)		(-0.405)		(-0.872)		(-0.761)	
f_4	2.279***		2.313***		2.232***		2.305***			
	(-0.615)		(-0.597)		(-0.627)		(-0.613)			
f_6					0.003		0.004		0.006	
					(-0.005)		(-0.005)		(-0.005)	
f_8									4.678***	
									(-1.223)	
f_1^2			-1.104**							
			(-0.556)							
f_3^2	-1780.311***		-1808.291***				-1738.925***		-1923.595***	
	(-439.928)		(-429.796)				(-436.301)		(-409.564)	
f_6^2									-0.111**	
									(-0.045)	
σ	1.328***	0.369***	1.326***	0.365***	1.263***	0.345***	1.31***	0.368***	0.975***	0.327***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.903***	0.98***	0.926***	0.984***	0.896***	0.974***	0.911***	0.982***	0.986***	0.99***

	(-0.07)	(0.011)	(-0.053)	(0.009)	(-0.082)	(0.02)	(-0.069)	(0.011)	(-0.016)	(0.008)
Logli	1507.962		1509.734		1512.196		1508.577		1506.14	

Table 9 (Continued)

Panel F: Univariate estimates output of High Yield Fixed-Income Fund Portfolio

Variable	(1) S_t=1	(1) S_t=2	(2) S_t=1	(2) S_t=2	(3) S_t=1	(3) S_t=2	(4) S_t=1	(4) S_t=2	(5) S_t=1	(5) S_t=2	(6) S_t=1	(6) S_t=2
Estim	0.023%		-0.02%		-0.076%		-0.092%		0.001%		0.237%***	
	(-0.001)		(-0.001)		(-0.001)		(-0.001)		(0.000)		(-0.001)	
f_1	0.497***		0.423***		0.453***		0.424***		0.387***		0.432***	
	(-0.071)		(-0.087)		(-0.065)		(-0.084)		(-0.083)		(-0.064)	
f_6					0.118***		0.117***		0.107***		0.085***	
					(-0.023)		(-0.023)		(-0.019)		(-0.022)	
f_8											-32.075***	
											(-3.869)	
f_1^2			5.682				2.182		4.935			
			(-4.094)				(-3.992)		(-3.61)			
f_6^2									-0.587***			
									(-0.22)			
σ	2.841***	0.84***	2.895***	0.828***	2.341**	0.831***	2.361**	0.828***	1.943***	0.687***	1.825***	0.734***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.811***	0.955***	0.809***	0.955***	0.837***	0.963***	0.837***	0.963***	0.838***	0.928***	0.842***	0.946***
	(-0.093)	(0.025)	(-0.089)	(0.024)	(-0.089)	(0.028)	(-0.089)	(0.027)	(-0.094)	(0.053)	(-0.089)	(0.037)
Logli	564.84		565.785		581.653		581.8		586.273		595.522	

Variable	(7) S_t=1	(7) S_t=2	(8) S_t=1	(8) S_t=2	(9) S_t=1	(9) S_t=2	(10) S_t=1	(10) S_t=2	(11) S_t=1	(11) S_t=2
Estim	0.056%		0.168%		-0.302%		0.47%**		0.187%	
	(-0.001)		(-0.004)		(-0.002)		(-0.002)		(-0.002)	
f_1	0.446***				0.429***		0.421***		0.409***	
	(-0.065)				(-0.063)		(-0.059)		(-0.06)	
f_2					4.877***					
					(-1.777)					
f_3			-8.139				-15.343***		-11.224**	
			(-7.273)				(-5.09)		(-5.063)	
f_6	0.102***		0.105***		0.089***		0.08***		0.083***	
	(-0.023)		(-0.02)		(-0.021)		(-0.02)		(-0.019)	
f_8	-5.644		-11.914		-5.383***		-2.996***		-4.544*	
	(-9.624)		(-8.259)		(-3.823)		(-5.089)		(-8.478)	
f_3^2			6921.975**				9475.948***		7711.413***	
			(-3192.129)				(-2362.014)		(-2335.595)	
f_8^2	-12720.273***		-11262.904***						-9887.311***	
	(-4388.299)		(-3938.287)						(-3757.792)	
σ	1.542***	0.669***	1.43***	0.753**	1.601***	0.731***	1.395***	0.589***	1.413***	0.6***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.865***	0.919***	0.828***	0.889***	0.864***	0.944***	0.885***	0.916***	0.853***	0.908***
	(-0.079)	(0.05)	(-0.123)	(0.131)	(-0.086)	(0.038)	(-0.061)	(0.043)	(-0.083)	(0.05)
Logli	596.346		590.739		599.522		608.396		610.985	

Table 10: Estimates of Multivariate Regime-Switching Model with Timing Coefficients not State-Dependent

This table reports multivariate regime-switching estimates of following model $\boldsymbol{r}_t = \begin{bmatrix} r_{CFI} \\ r_{CMM} \\ r_{CSTFI} \end{bmatrix} = \boldsymbol{a}_{s_t} + \sum_{i=1}^{I} \boldsymbol{\beta}_{i,s_t} \boldsymbol{f}_{i,t} + \sum_{j=1}^{J} \boldsymbol{\Lambda}_j \boldsymbol{f}_{j,t}^2 + \boldsymbol{\varepsilon}_t$

where $\boldsymbol{a}_{s_t}$ estimate fund manager's performance in state s_t,$\boldsymbol{\beta}_{i,s_t}$is risk exposure to market factor $\boldsymbol{f}_{i,t}$ in state s_t, $\boldsymbol{\Lambda}_j$isloading on quadratic market factor$\boldsymbol{f}_{j,t}^2$, and $\boldsymbol{\varepsilon}_t$~N$(0, \Sigma_t^*)$ is a state-specific variance covariance matrix, Σ_t^*. Switches of state variable between two states, s_t , are governed by a transition probability which is a realization of first-order Markov chain on a constant transition probability. We consider a parsimonious model with k=2. $\boldsymbol{r}_t$ comprise three value-weighted portfolio excess returns on 30-day TB rates: Canadian Fixed-income Funds (CFI), Canadian Money Market Funds (CMM) and Canadian Short Term Fixed-income Funds(CSTFI). Market factors aggregate bond index (f_1), default premium (f_2), term premium (f_3), mortgage spread (f_4), inflation changes (f_5), TSX-300 (f_6), banker acceptance rate (f_7), stock market volatility (f_8). Standard errors of coefficients are reported in parenthesis under estimates of coefficients. Estim is the intercepts, σ is the percentage of standard deviation of residues, logli denotes the log-likelihood, and P reports the persistent transition probability p_{11} in state 1 and p_{22} in state 2. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

	(1)						(2)						(3)					
	CFI		CMM		CSTFI		CFI		CMM		CSTFI		CFI		CMM		CSTFI	
Variable	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2	S_t=1	S_t=2
Estim	-0.613%***	-0.333%***	-0.056%***	-0.043%***	-0.168%**	-0.127%***	-0.843%***	-0.501%***	-0.074%***	-0.072%***	-0.188%**	-0.077%***	-0.093%	-0.729%***	-0.086%***	-0.087%***	-0.445%	-0.581%***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.001)	(0.00)	(0.001)	(0.00)	(0.00)	(0.00)	(0.001)	(0.00)	N/A	(0.00)	(0.00)	(0.00)	(0.003)	(0.001)
f_1	0.82***	0.972***			0.278***	0.33***	0.793***	0.967***			0.269***	0.295***	0.798***	0.963***			0.275***	0.253***
	(0.017)	(0.014)			(0.029)	(0.024)	(0.018)	(0.011)			(0.035)	(0.021)	(0.03)	(0.012)			(0.037)	(0.018)
f_3													-2.969**	0.506*	0.362***	0.384***	7.795***	5.292***
													(1.242)	(0.268)	(0.139)	(0.057)	(2.244)	(0.417)
f_4			0.153*	0.083			0.312	-1.123***	-0.051	-0.103	0.042**	0.000	-3.888***	3.018***	0.002	0.012***	-2.947	2.472***
			(0.09)	(0.081)			(0.618)	(0.209)	(0.095)	(0.081)	(0.018)	(0.002)	(0.559)	(0.228)	(0.004)	(0.001)	(3.11)	(0.603)
f_7									0.002	0.013***					1.228	0.313***		
									(0.003)	(0.001)					(0.909)	(0.076)		
f_1^2	-0.931***				-0.293		-1.017***				-0.722		-1.491***				0.085	
	(0.347)				(0.606)		(0.285)				(0.555)		(0.363)				(0.464)	
f_3^2													-138.438***		-71.936**		-1067.494***	
													(0.216)		(30.123)		(0.168)	
f_4^2			4.09				1735.158***		173.637***		-0.032				-0.032***			
			(39.559)				(0.653)		(36.535)		(0.039)				(0.011)			
f_7^2									-0.022**									
									(0.01)									
σ	0.529***	0.179***	0.062***	0.019***	0.853***	0.299***	0.512***	0.181***	0.065***	0.02***	0.951***	0.343***	0.766	0.213***	0.069***	0.022***	0.995***	0.332***
	(0.000)	(0.000)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	N/A	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	0.979***	0.974***					0.959***	0.971***					0.897***	0.953***				
	(0.012)	(0.015)					(0.019)	(0.012)					(0.041)	(0.017)				
Logli																		